Electrical World

The consolidation of ELECTRICAL WORLD and ENGINEER AND AMERICAN ELECTRICIAN.

VOL. 57. NEW YORK, THURSDAY, FEBRUARY 16, 1911. No. 7.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK.

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TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All Other Countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday of the week of issue.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1910 was 974,750. Of this issue 17,500 copies are printed.

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DISCRIMINATION IN POSTAL RATES.

A measure affecting the interests of subscribers to technical journals has come before Congress in the form of an amendment to the post office appropriation bill. In a rider to the appropriation bill it is proposed to increase from 1 cent to 4 cents per pound the rate of postage on the advertising sections of certain classes of publications. All the daily newspapers and certain small publications whose mailings per issue amount to 4000 lb. or less are to retain the rate of 1 cent per pound. The imposition of a rate of 4 cents per pound on the advertising pages of the popular magazines and on technical and trade journals (which have little or no political influence), while the great dailies with their enormous Sunday editions and their so-called Sunday magazines retain the rate of 1 cent, would, if enacted into law, constitute a rank discrimination. It would practically wipe out the profits of some publications and would put many reputable journals out of business. It would affect journals like the *Electrical World* to such an extent that they would be forced to pass at least a part of the burden on to their subscribers and advertisers in higher charges for services rendered. While this journal is perfectly willing to pay what it should to meet the needs of the government, it protests and asks its friends to protest against a proposal that threatens unnecessarily to cripple it. The postal deficit arises from inefficient management, not from low rates on second-class matter. The loss on the rural free delivery system should not be made up by exorbitant charges levied on the publishers of reputable periodicals.

THE CHICAGO TELEPHONE CONVENTION.

Having been once postponed, doubtless owing to important considerations of policy, the annual convention of the National Independent Telephone Association, held in Chicago on Feb. 8, 9 and 10, was awaited with interest in view of the great unrest in the telephone field. In the last year or two there have been many mergers or alliances of Bell and Independent companies and there have been rumors of still more important combinations in the last few weeks, the name of the financial house of J. P. Morgan & Company being freely mentioned in connection with the alleged negotiations. It was felt that the National Independent Telephone Association might make some declaration on the subject that would be interesting, at least, and perhaps of much importance. What the association did was to adopt resolutions saying that any statement to the effect that the officers of the association had been holding frequent conferences with the Bell company or J. P. Morgan & Company looking to the merging of all Independent and Bell interests was without foundation in fact; further, that the association was organized for the benefit of the strictly Independent operating companies; that the organization had never authorized

negotiations looking toward a merger with competing interests, and that it "avows its purpose to be the further development and the perpetuation of the integrity of the Independent telephone system as a whole." The first clause of these resolutions may be variously interpreted, but the concluding statement quoted seems to be a defiant declaration of adherence to competition rather than combination in telephone service.

The president of the association, Mr. Woods, who was active at the 1910 convention in introducing the contract plan of association organization, admitted that the parent Bell company has bought many Independent plants in the last few years in important centers. He recommended, first, the regulation of telephone companies by public-service commissions, and, second, compulsory physical connection, by law, of telephone properties. The association adopted resolutions strongly indorsing the first proposition. As to the second, the opinion at the convention seemed to be all in its favor and probably the most impressive address of the meeting was made by Mr. Theodore Gary in favor of it; nevertheless, there seems to have been no formal official action to recommend to the public and the lawmakers the compulsory physical connection of telephone properties. Many able men attended the convention, but there seemed to be some feeling of uncertainty in the air and the only important action was that summarized above. One result of the convention should be to give an added impetus to the public-service commission idea, for the Independents are numerous, geographically widespread and not without much political influence in many of the States.

LIGHTING IN ARCHITECTURE.

It would seem that each step taken in the development of decorative lighting has been initially a hazardously wasteful step from the standpoint of economics as existing at the time. Primitively, lights were used either to signal with at a distance or to find the path by. The notion of light as a decorative agent can hardly be said to have manifested itself in ancient times. The first possibilities in this direction came about with the production of candles in colored translucent chambers, such as glass bowls, or Chinese paper lanterns. Later developments arose with the advent of gas, when the architectural elements of a building could be clearly limned out at night by lines of gas jets. Still later developments arose with the various types of electric lamp as they appeared. But each new application for purely decorative purposes was essentially an extravagance at the time of its appearance. We are gradually coming to realize that if a decorative application of any kind can be made sufficiently pleasing to the mind its cost of production may be considerable and yet be not worth taking into account from the treasury of a large community. From a purely utilitarian standpoint there is perhaps no more extravagant and unjustifiable expense than that of suporting a picture gallery or a symphony orchestra, and yet a world in which neither of these forms of expenditure could find advocates would be a more sad and dismal world than ours. In the same way extravaance in expense of public lighting may be well worth while if the esthetic and decorative effects produced are commensurate, in the public estimation, with the cost.

For instance, in all recent national and international exhibitions, such as those of Paris, Chicago, Buffalo and St. Louis, a very prominent feature of the decoration has been the illumination of the buildings and grounds at night, both by electricity and by gas. Here the esthetic effects produced have been considered as outweighing the very considerable expense of the lighting equipment. It seems likely that the large cities will develop lighting effects more and more as time goes on. The change which has come about in this respect during the last decade is very striking. It is probably due not alone to greater facilities for supplying lighting, but also to a greater public appreciation of, and demand for, esthetic artificial outdoor illumination. It is particularly in this direction that the progress of illuminating engineering toward more efficient illuminants will be of great public service. Doubling the illuminating value of a given amount of electrical power means a vast esthetic possibility of gain.

MEASUREMENTS OF INTRINSIC BRIGHTNESS BY A NEW METHOD.

It is a remarkable fact that the most elementary and fundamental visual concept is that of brightness. Yet in our industrial and scientific measurements, or in our photometric literature and discussions, the term and the measure of brightness are conspicuously absent. When we direct our eyes toward any group of illuminated objects we are ordinarily conscious at once of differences in their brightness, and it is largely owing to such differences in brightness that we are able to interpret the image formed on the retina in relation to the qualities and disposition of the objects viewed. Similarly, when we look at a group of luminous sources the differences between their brightness is the first conception ordinarily formed in the mind. Yet when we come to examine text-books on photometry, or on the photometric aspects of vision, it is remarkable how much is left unsaid concerning brightness by comparison with what is said concerning luminous intensity, luminous flux, illumination and other topics. Yet these subjects so voluminously discussed are secondary to brightness in the order of psychological development.

One reason for the modesty of brightness in our literature and speech, as compared with its assertiveness in sensation, is that we have had very few methods of, or means for, measuring it. The brightness of a luminous source may be defined as the surface density of its candle-power, as measured perpendicularly to the surface. If we know the candle-power of a luminous source, as well as its surface area in square centimeters and the geometrical relations of that surface, we can derive the candle-power per square centimeter or brightness of the source. In general, the brightness will not be the same at all parts of the surface. Moreover, except when a lamp is inclosed in a translucent and heavily frosted globe it is not easy to find the surface area of the source. In the case of a candle-flame, for instance, we find it hard to determine the surface area of the flame, and the brightness of the flame expressed in candles per square centimeter differs in different parts of the flame. Messrs. Herbert E. Ives and M. Luckiesh describe, on page 438 of this issue, an interesting method of measuring the brightness at, or in the immediate vicinity of, a point on a

luminous surface. It consists essentially in superposing on the retina of the eye the image of the said point on the image of a luminous surface of known and adjustable brightness in such a manner that the two images blend together without perceptible discontinuity when the two brightnesses are equal. Strictly speaking, of course, this assumes that the two brightnesses compared are homochrome, or of the same color. If the two brightnesses are heterochrome, or do not match in color, then no perfect blend can be made and an estimate only can be formed of their relative brightness as in ordinary heterochrome photometry.

The plan ingeniously adopted is to form an enlarged image of a glowing Nernst filament beyond a condensing lens and to examine with a telescope against this image as a background that of the luminous source at the point to be tested. In the case of incandescent-lamp filaments the image of the Nernst glower is formed at the filament and the contrast of the glowing filament against the glower image is made to disappear. This measures the brightness of that particular small element of the filament, as within the glass lamp bulb, in terms of the known brightness of the Nernst glower. It is mentioned that the brightness of the ordinary filament varies materially from point to point, an observation which is not ordinarily apparent to the unaided eye. In the case of a flame, or of a bulky luminous source, a filamentary image has to be made of the particular part of the surface considered, by means of a little filamentary mirror, and the measurement made as before, after allowing for the losses of brightness in reflection. The apparatus is a very pretty one and should be developed into a standard instrument. It should prove very useful to the illuminating engineer in many ways. The standard source of brightness, whether a Nernst glower or a large tungsten filament, will need to be carefully standardized and calibrated, as also the condensing lens, the Nichols prism and the filamentary mirror. If these elements could be worked up by a manufacturer of photometric apparatus for the purposes of the photometric or factory laboratory a real benefit would be derived by photometrists and the demand for the apparatus might be substantial.

QUANTITATIVE ANALYSIS OF MUSICAL TONE.

As we all know, the telephone reproduces at a distance the sounds of the speaker's voice through the aid of alternating currents over the wires connecting the speaker and listener. Moreover, the reproduction of speech is sufficiently good to be practically satisfactory over the normal telephone circuit. On the other hand, we know that the sound reproduction is far from being perfect—partly by experience, since we frequently fail to recognize through the telephone the voice of an interlocutor, and partly by theory, since a diaphragm is unable to vibrate equally to all frequencies of impressed vibrations. It responds to certain favorite frequencies much more powerfully than to those outside the friendly circle, while to some unfriendly frequencies it refuses appreciably to respond.

There are certain sounds that a telephone ordinarily reproduces powerfully, such as the *oo* sound in *cool;* other sounds it reproduces very weakly, such as the sibilant sounds, final *s,* and the like. The word *specie* is much disliked by the telephone, and what it delivers in this case is usually *pea-ee.* Much depends, of course, on the strength and clearness of the vocal tones delivered to the transmitter diaphragm, and on the distance of the speaker's lips from that diaphragm. We all become more or less expert in deciphering and guessing the sounds uttered by the receiving telephone, and, ordinarily, we succeed very well; but there can be no doubt that languages of large and clear vowel sounds, like the Italian, have a distinct advantage for telephonic purposes over languages that, like our own, use the half-closed more than the widely opened lips.

As soon as we attempt to investigate, quantitatively, the extent to which the telephone reproduces the sounds it receives we find ourselves struggling in a vortex of difficulties. The movements of the receiving telephone diagram are so small in their amplitude that, for a long time, it was contended that there was no actual vibration of the diaphragm, but only a molecular vibration within its substance. This feeble amplitude makes the analysis of the sounds uttered by the receiving telephone extremely difficult. Then the alternating currents conveying the sounds are of very feeble amplitude and are difficut to analyze. Again, the sounds of ordinary speech are so complex as to make the inquiry too difficult, even confined to the transmitter alone. Simple uniform standard sounds must be used that can be reproduced indefinitely without fatigue. If we blow steadily into a simple instrument, like the cornet, we shall produce not a single simple musical tone, but a combinations of various tones superposed, and it is difficult to analyze the resultant tone into its components.

In order to arrive at a final solution of the problem, it becomes necessary as a first step to analyze the sound emitted by the standard source into its fundamental and harmonics, assigning to each component its proper intensity. An experimental research in this direction has recently been published by Mr. P. H. Edwards in *The Physical Review.* The plan consisted in mounting a series of Helmholtz resonators, tuned to respond to a series of ascending musical tones, and suspending in the mouth of each resonator a Rayleigh disk, consisting of a mica disk, smaller in diameter than the resonator mouth and carrying a minute mirror. The disk is suspended in a vertical plane by a fiber and is damped in its motion by a little vane dipping into oil. The plane of the disk is set to make an angle of 45 deg. with the plane of the resonator mouth. When the resonator is excited the vibration of the air into and out of the resonator mouth tends to turn the disk to close the mouth, like a small throttle-valve. By measuring the movement of a spot of light reflected from the mirror on a scale the intensity of each component harmonic in the composite sound may be measured. When a violin was bowed near the above series of resonators it was found that the fundamental tone was very weak in the lowest notes, much weaker than the octave triple-frequency harmonic, or double octave. In the higher notes this was not the case. Curves accompany the paper, showing that not only do different violins differ very much in their tone-composition on one and the same note, but that one and the same violin differs very much in its tone-composition on different notes. It would seem possible, by such experimental procedure, to ascertain what are the essential features of a sweet musical tone in an instrument and to submit the instrument to a quantitative test throughout the whole range of its register. At a later stage the method should be applicable to telephonic investigation.

Public Policy Work of the N. E. L. A.

For some months past the public policy committee of the National Electric Light Association has been studying the various problems connected with "welfare" work; and last year the association sent Dr. W. H. Tolman abroad to secure for it the latest data as to European practice, the chief countries investigated being Germany and England. Conditions in this country have also been looked into closely. With the object of forecasting its suggestions to the membership at the next convention in New York City, the committee held a meeting in Washington last week, and remained in continuous session throughout Friday and Saturday, Feb. 10 and 11, at the New Willard Hotel. There were present Messrs. C. L. Edgar, chairman; W. W. Freeman, president; N. F. Brady, E. W. Burdett, H. M. Byllesby, H. L. Doherty, G. H. Harries, S. Insull, J. B. McCall, S. Scovil, W. H. Blood, Jr., Arthur Williams, T. E. Murray, president of the Association of Edison Illuminating Companies; R. S. Hale, and T. C. Martin. The committee discussed most exhaustively and reached conclusions to be embodied in suggestions for action by member companies, where such plans have not been put in force already, as to provision for accident insurance, sickness insurance, profit-sharing by employees, and the payment of annuities as a recognition or reward for continuous and meritorious service.

Philadelphia Electric Show.

Philadelphia's electric show was thrown open to the public Monday night when Mayor Reyburn pressed the button which set in motion all of the machinery and appliances in the exhibition. As heretofore the show is being held in the First Regiment Armory, at Broad and Callowhill Streets. The decorations of the building are very handsome. The entire floor has been laid out as a Venetian garden and presents a beautiful and pleasing aspect. The various booths which contain the exhibits of the many firms are gayly decorated and covered with electric lights of many colors. Myriads of electric lamps of every type, from the powerful flame arc to the tiny miniature, are used in the decoration. Broad Street has been spanned with numbers of electric arches from the City Hall to the Armory.

Pending Legislation Regarding Niagara Falls.

After June 1 the diversion of water from Niagara Falls is subject to the discretion of the Secretary of War, limited only by the international treaty between the United States and Great Britain. The Burton act expires by limitation at that time, and although the existing treaty permits 20,000 cu. ft. of water per second to be diverted by each country, the Burton act limits the diversion upon the American side to 15,600 cu. ft. per second, but permits a temporary increase of diversion under revocable permits, so that in case the increased diversion affects the falls it may quickly be stopped. It further restricts the quantity of power that may be brought into the United States from Canada to 160,000 hp, with revocable permits in addition, but the aggregate must not exceed 300,000 hp. For a fuller text of the provision of the Burton act and its effect on electrical developments at Niagara Falls the reader is referred to the *Electrical World*, June 29, 1907. Many of the predictions made at that time have come to pass, and in view of the reciprocity treaty now pending before Congress the following concluding paragraph of the article in question is of interest: "The net result, therefore, and the probable effect of the Burton bill, if continued, is a restriction within the State of New York of the use of Niagara power to substantially the amount of the present demand and the forcing of the three great plants now partly constructed on the Canadian side to seek a market in Canada for about two-thirds of the output of their completed plants instead of transmitting the larger part of that power to the State of New York and possibly beyond as originally intended. There is every indication pointing to the belief that even without change in tariff schedules the Canadian market eventually will be sufficient to absorb all the power originally intended for American consumption. A substantial reduction by the United States in tariff rates on manufactured articles would stimulate the power market in Canada to a point where the demand would precede the rate of installation of all the additional generating units."

There is now pending in the rivers and harbors committee of the House of Representatives a measure known as the Alexander bill which seeks to remove entirely the restrictions upon the transmission of energy from Canada into the United States and further provides for the permanent diversion of water on the United States side to the maximum of 20,000 cu. ft. per second. The bill does not increase the amount of water that may be taken from the Niagara River at the falls as already provided for by treaty, but merely seeks to render the amount agreed upon available and not subject to revocable permits and seeks also to provide an outlet for surplus energy developed on the Canadian side. At the present time the limit of the amount of power that may be imported from Canada into the United States has almost been reached.

St. Lawrence Power Project Likely to Be Defeated.

By a vote of sixty-six to eighty-four the House of Representatives on Feb. 7 defeated the plan proposed for damming the St. Lawrence River at Long Sault Rapids, although the bill for this purpose was unanimously reported from the rivers and harbors committee. Opposition to the measure was put upon the ground that it did not conform to the new policy of the United States for the conservation of water-power and that it granted a ninety-nine-year lease when the general dam act fixes the limit in such cases to fifty years. A hearing was held by a sub-committee of the committee on commerce in the Senate on Feb. 8, but no action has as yet been reported.

The Long Sault Development Company, which is closely allied with the Aluminum Company of America and in whose interest the present bill was drafted, obtained a perpetual charter from the State of New York and owns the riparian rights on both sides of the St. Lawrence River at the rapids. It is estimated that 500,000 hp can be developed from the water and the estimated cost of the development was placed at $40,000,000.

In Canada public sentiment, educated by the success of the Hydroelectric Power Commission of Ontario, is opposed to the grant. The Canadian government does not object to the damming of the South Sault if it is properly canalized, but objects to anything that will interfere with navigation on the North Sault, which is partly in American and partly in Canadian territory. The feeling prevails in Canada that the generation of electricity should be so controlled that the energy will be equally distributed to the citizens of the two countries at fair and reasonable rates. Similar views have been expressed by the chairman of the American Section of the International Waterways Commission.

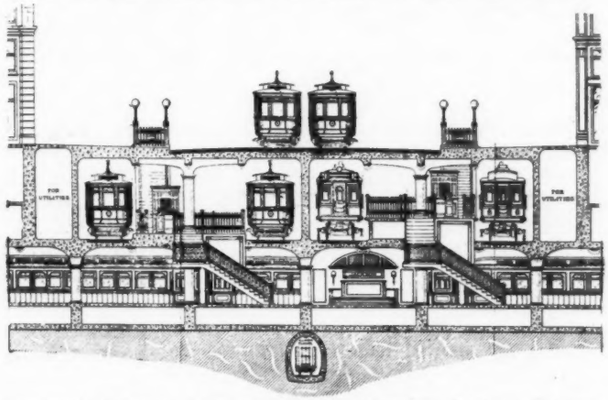
Arnold Report on Chicago Passenger Subway System.

As noted briefly in the *Electrical World* of last week, Mr. Bion J. Arnold, chief subway engineer for the City of Chicago, presented his report, entitled "General Statement of Problem and Description of Plans for a Passenger Subway System for the City of Chicago," to the City Council of Chicago on Feb. 6. The report consists of a printed pamphlet of seventy-five pages with twenty-three maps and plates.

Mr. Arnold remarks that he has studied the transportation problem of Chicago for nearly a decade. He recommends what he calls Plan No. 1, shown in its developed state as a system of high-speed subways extending over the entire city. It is not proposed, however, that this comprehensive plan of subways shall be built at once, but rather in five steps or stages, which are carefully described in detail. From a comparatively small

nucleus it is thus proposed ultimately to build a comprehensive subway system for the whole city, constantly tending to enlarge the present business district and capable of unlimited expansion. Plans are ready for the construction of the first step outlined and specifications and detailed drawings can be prepared so that contracts could be let for this portion of the subway within sixty days from the date that authority is given to proceed with the work. The report of Mr. Arnold was referred to the local transportation committee of the City Council. In the annual Chicago municipal budget for this year is an item of $2,035,000 to provide for the beginning of subway construction.

Mr. Arnold points out that the problem of preparing working plans for a subway system in Chicago is especially difficult, not only by reason of the existence of about sixty miles of freight tunnels under the streets in the central business district, these tunnels being in general but 33 ft. below the surface of the streets, but also from the further fact that the policy of the city is not yet settled as to the method of financing subways.



Proposed Chicago Subways—Section Showing Surface Routes, High-Level Subway, Low-Level Subway and Freight Tunnel.

Plan No. 1, which Mr. Arnold favors if practicable, is designed so that by its means high-speed and local trains could be operated independently of any of the present traction companies, if desired. Upon the tracks of this subway could be run at first the present surface-line cars, later the present elevated railway trains, and finally, when extended, the trains of a high-speed comprehensive subway system covering the entire city.

Plan No. 2 is intended to apply to a system designed to be used exclusively by the surface-line cars for the relief of present congestion in the central business district, utilizing the existing tunnels under the river and so located that it would not interfere with the ultimate construction of the high-speed subway of Plan No. 1. Mr. Arnold remarks that no extensive subway system can be justified from an investment viewpoint unless it is so designed that ultimately high-speed trains, each having a carrying capacity of not less than ten of the present elevated cars, could be operated through it at times of maximum traffic.

Plan No. 1 as recommended provides through-routing from the northern part of the city to the southern part and vice versa, as well as from some of the east and west streets and from the diagonal subways, but it makes no attempt to secure universal through-routing. After considerable planning, by adopting reinforced-concrete steel construction and in some instances combination I-beam and concrete construction, designs have been developed which if followed will permit the construction of both high-level and low-level subways of sufficient size without interfering seriously with the freight tubes of the Illinois Tunnel Company. Shallow construction for the high-level subways will permit sufficient room for the low-level subways to pass beneath them and over the freight tunnels. As the first step of Plan No. 1 it is proposed to construct the downtown nucleus with six stations, that at State Street and Jackson Boulevard being shown in the illustration. This step provides for 7.8 miles of single track in a two-track subway and is estimated to cost $8,000,000. The subway would be constructed so that two additional tracks, making a four-track subway, could be added when needed.

The electrical energy necessary for the operation of the initial subways will be delivered at the busbars of the substation, or substations, which will be located along the line of the subway. These substations will be supplied with three-phase energy coming through underground mains at high potential and stepped down by air-cooled transformers of 2000 kw to 4000 kw before being passed through rotary converters. The direct-current output of these rotaries will be distributed by means of a low-tension switchboard to the various sections into which the overhead trolley for surface cars and the third-rail for elevated railway trains will be divided under the control of a load dispatcher. "The great importance of continuity of service and the known weakness of feeders," says Mr. Arnold, "will make advisable the installation of a distant-control equipment whereby the load dispatcher may change the distant connections between feeders and the contacting trolley or third-rail as easily as he may disconnect and rearrange the feeders on the substation switchboard."

The report contains a number of appendixes giving details of routes in various streets and connections with existing surface and elevated railways. The report shows evidence of care and thoroughness in its preparation and is distinguished by clarity and conciseness.

SUBWAY DISCUSSIONS.

Apropos of the presentation of the Arnold report a paper presented at the regular meeting of the Western Society of Engineers in Chicago, Feb. 8, by Mr. A. S. Robinson, on "The Shuttle System of Chicago Subways," is of some interest. The author divides Chicago, for transportation purposes, into a northern and a southern section, with an imaginary boundary line at Monroe or Adams Street. Cars would be routed entirely through the business district from one section to the other, either to convenient points in the vicinity of the portals or to the ends of the lines, where their direction would be reversed for a return trip. These lines would be in high-level subways and might be connected by a low-level subway on Monroe and Adam Streets, acting as a transfer only. At the crossings of the high-level subways one line is carried beneath the other to avoid grade crossings, coming again to the upper level as rapidly as possible.

In the discussion letters were read from Mr. Bion J. Arnold, chief subway engineer of Chicago, and Mr. John Ericson, city engineer. Mr. Arnold said that he had been unable to give the time to the paper to discuss it properly. Mr. Ericson pointed out the desirability of placing public-utility conduits under sidewalks and in alleys. Mr. George Weston, of the Board of Supervising Engineers, Chicago Traction, took issue with the author on several points and said he concurred with the recommendations of the Arnold report in many respects. Mr. Weston also remarked that none of the plans so far proposed contemplates any change in the Illinois Tunnel Company's grades. Mr. Boucher elucidated Mr. Arnold's report and said that the estimated cost in Mr. Robinson's paper ($2,513,000 per mile of double-track subway equipped ready to operate) as taken from bids obtained in New York was too high for Chicago conditions. Mr. P. E. Green remarked that there did not seem to be a full realization of the amount of space under the streets taken up by public utilities. In some streets these structures as at present installed take up practically the whole width of the street from curb to curb. The paper was also discussed briefly by Messrs. A. J. Saxe, Emil Gerber and H. H. Evans.

Addressing the Chicago Real Estate Board, on Feb. 9, Mr. Charles V. Weston, president of the South Side Elevated Railroad Company, said that before the city enters extensively into the building of subways it must have a great density in population in order to meet the financial side of the problem. He said that the present street and elevated railways of Chicago were not operated to their full capacity owing to congestion in the central business district.

Independent Telephone Convention Denies Merger and Indorses Public-Service Commissions.

Unusual interest attached to the annual convention of the National Independent Telephone Association in Chicago on Feb. 8 to 10, owing to the widespread reports of the merger of many important Independent telephone companies with the Bell interests and also to the reported activities of the financial house of J. P. Morgan & Company in the telephone field. Another subject of interest was the relation of the telephone industry to State and governmental regulation, particularly as exemplified of late by the regulation of interstate telephone traffic by the Interstate Commerce Commission at Washington.

The attendance at the convention was perhaps 550, of whom about half were telephone operating men and the remainder supply men. An exhibit of telephonic appliances was made in connection with the convention. An air of suppressed excitement pervaded the convention, but the principal business was transacted in committee meetings and private conferences, as usual. The association took important action in confirming its complete independence of Bell interests, and also stating its adherence to the principle of the regulation and control of all public-service corporations by duly empowered commissions. Compulsory non-discriminatory physical connection of telephone properties, whether Bell or Independent, was also strongly urged in the convention, and appeared to be favored by nearly all the delegates present, but no official action in relation to it was taken. In resolutions adopted in relation to public policy, which were carried without opposition, reports that the merging of Independent and Bell interests had been sought by officers of the Independent association in conferences with Bell officials and representatives of J. P. Morgan & Company were expressly denied by the association, which reaffirmed its adherence to the principles and development of Independent telephony.

A resolution was also passed demanding the regulation and control of all public-service corporations by State commissions having the power to fix rates, both maximum and minimum, so that protection might be secured against competitive rate-cutting. Congress was also asked to vest the Interstate Commerce Commission with similar powers for interstate telephone business, clearing up ambiguities which exist in the present Interstate Commerce Law as written.

OPENING PROCEEDINGS—PRESIDENT'S ADDRESS.

The convention was late in assembling on Wednesday morning, Feb. 8. Mr. Howard W. Hayes, assistant corporation counsel, welcomed the association to Chicago on behalf of Mayor Busse. He reviewed the telephone situation in Chicago, and spoke a good word for telephone competition. An eloquent response on behalf of the association was made by Mr. Nelson G. Hunter, of Wabash, Ind.

President Frank H. Woods, of Lincoln, Neb., who presided, delivered his annual address, which was couched in conversational language. In a part of the field the point of saturation in telephone service has been reached, he said, but in other parts ample opportunity for competition exists. The American public invited telephone competition, but has provided no means to prevent competition from being attacked or destroyed, and various illegal mergers have been permitted. Mr. Woods believes that the American Telephone & Telegraph Company is finally convinced that it cannot own and control all the telephone properties of the country. This company has bought many Independent plants in the last few years in important centers, but is apparently content that thousands of small companies shall remain Independent.

Mr. Woods made two important recommendations. The first is the regulation of telephone service by public-service commissions, and the second is compulsory physical connection between telephone systems. The anti-trust laws have failed to check monopoly through lack of enforcement. Many Independent companies have reached a point where readjustment of their rates is demanded. This, in the face of cut-throat competition, he said, should be intrusted to a public-service commission. Furthermore, commission control will be an effective check on fraudulent promoting, and the commission can also decide whether competition shall be allowed in any community. The public-service commission should not only regulate rates, but fix them. Mr. Woods said that the tendency even among the Independents is toward consolidation. Two large systems have grown up, but such a condition cannot be permanent. If one group of properties reaches one section and another group another section, interconnection must be made. The public has desired competition, and the Independents have given it; if the public desires universal service, the Independents must give that also. But the principle of telephone competition must be preserved, the exact method of interchange being decided by the commissions. Real universal service should be given—not, he said, the kind advertised by the Bell company. Private branch exchanges may have trunk lines connecting to the exchanges of two competing companies, thus giving the subscriber connection with the two systems. Competition should be retained, declared Mr. Woods, but not under conditions that make the service too expensive or annoying. One company should control both the long-distance telephone and telegraph service. Just how to make the adjustment where two local companies exist is a question to be left to the future and be decided under the jurisdiction of the public-service commissions. Heretofore the Independents have been opposed to interchange with Bell companies because they felt they were not treated fairly.

The president spoke of the difficulty the Independents experience in raising money to make extensions. However, there is no more reason for discouragement in this respect now than at any time in the past. The trouble is due to the close connection of the Bell interests with the men powerful in the money market. But competition has proved its worth. The present development of Independent telephone interests represents an investment of $350,000,000.

Mr. J. B. Ware, of Chicago, secretary and treasurer, presented his report, in which he spoke of the raising of a special fund of $125,000 during the year to meet the grave crisis in the Independent telephone field. The association has a card index of 18,662 Independent telephone companies which are now in operation. Of these perhaps 5000 are commercial companies, the remainder probably being principally rural or neighborhood systems. Mr. Ware showed how the low Independent telephone rates have led to a very large increase in the use of residence telephones, and said that in the Central West the number of city telephones is about 10 per cent of the population.

GENERAL BUSINESS.

On Thursday morning Mr. Manford Savage, of Champaign, Ill., read a paper on various aspects of the rate question. Mr. Savage favors regulation by general public utility commissions rather than by purely telephone commissions. The commission form of government for cities, he said, is a promising departure from the viewpoint of the telephone companies.

The subject of reciprocal or mutual insurance of telephone properties was discussed by Mr. J. B. Hoge, of Cleveland, general manager of the Telephone Fire Insurance Exchange. The plan adopted involves the use of emergency switchboards adapted to all classes of service, to be shipped quickly from Chicago wherever needed in case of fire. Mr. B. G. Hubbell, of Buffalo, indorsed the scheme of telephone companies placing a portion of their insurance on the mutual plan, particularly income insurance or use-and-occupancy insurance. Mr. Theodore Gary, of Macon, Mo., also indorsed the plan. Mr. Woods, of Lincoln, Neb., remarked that the work Mr. Hoge is doing is resulting in the equalizing of insurance rates on telephone properties.

President Woods appointed Mr. N. G. Hunter, of Wabash, Ind., chairman of the committee on resolutions, the other members being Messrs. E. H. Moulton, of Minneapolis; J. H.

Wright, of Jamestown, N. Y.; Walter J. Uhl, of Logansport, Ind., and H. D. Critchfield, of Chicago.

Matters connected with pending negotiations were discussed in an executive session of the association Thursday afternoon. No official statement of what transpired at the secret meeting was vouchsafed, but it was stated that the report of the committee on credentials was adopted without opposition and that during a recess the burning questions of the convention, such as the absorption of important Independent companies by the Bell interests, the Ohio situation and the relation of J. P. Morgan & Company to the telephone industry, were discussed informally and freely.

On Thursday evening there was a banquet at the Hotel LaSalle. Mr. Manford Savage was toastmaster, and speeches were made by Messrs. B. G. Hubbell, of Buffalo; Nelson G. Hunter, of Wabash, Ind.; Col. Will Visscher, of Chicago, and Mr. H. D. Critchfield, of Chicago.

COMPULSORY PHYSICAL CONNECTION.

Vice-President E. B. Fisher, of Grand Rapids, Mich., presided part of Friday morning, when was delivered probably the most important address of the convention, that of Mr. Theodore Gary, of Macon, Mo., on "The Effect of Compulsory Connection on the Future of Independent Telephone Companies." Mr. Gary first reviewed the history of such connection between competing companies, as established by the sublicensee agreement of 1904. Later the Independent companies, to meet the onslaughts of the Bell interests, undertook to provide exclusive contracts between the Independent companies themselves. The courts in Missouri have decided one clause of these contracts to be contrary to the State anti-trust laws, although the case is still pending. In Ohio, in a similar case, judicial opinion is divided. In Oklahoma there is a constitution provision that telephone companies must interchange traffic. In Montana and South Dakota connections between all telephone companies may be enforced. In all these states, however, the principle of the validity of exclusive contracts is still in the courts and has been passed upon by no court of last resort. The speaker asserted that at the present time there is physical connection to competing exchanges between about 8000 telephone companies, supplying 2,000,000 subscribers' stations. This connection has not been compulsory, but is the result of the immutable law of supply and demand.

Independents look with suspicion on those who connect with Bell companies as not "true blue," but Mr. Gary now thinks the matter might have been worked out differently several years ago when the subject of physical connection was first broached. Such connections are now a condition and not a theory. The question is whether in the future they shall be made by contract, or by statute and not be confined to a favored few. Mr. Gary believes that the connection should be made compulsory under the supervision of public-service commissions. The National Independent Telephone Association made a bad mistake some years ago, he thought, in handling the connection question sentimentally instead of as business men should. The fact that Mr. Gary himself advocated such compulsory physical connection four years ago showed that the idea was not a recent Bell or Morgan project. In the speaker's opinion such connection is bound to come, and the Independent companies should prepare their statements and have something to do with the manner in which the subject shall be handled by commissions. Mr. Gary opposed physical connections on a contract basis providing for exclusive service. Independents, he said, should insist on real universal service. In Missouri the Independent companies will not make contracts with the Bell organization unless every other telephone company has the same privilege.

But before compulsory physical connections can be enforced general powers must be given to the interstate and State commissions. These commissions should define apparatus standards, apportion costs of making connections, consider the replacement of obsolete apparatus and have authority to fix rates. The law might even require the sender of a message to designate the route over which he wishes to talk just as a traveler at a union railroad passenger station buys a ticket on the road he wishes to patronize. Penalties should be provided for discrimination, and the law should give equitable compensation to each company handling the message. The right to appeal to the commission should be preserved, and it might be necessary to invoke the right of eminent domain to make physical connection with the switchboards of competing companies.

CONCLUDING PROCEEDINGS.

Mr. Woods took the chair at the conclusion of Mr. Gary's speech, and in relation to the status of telephone companies before the Interstate Commerce Commission at Washington said that such companies are not obliged to appoint residential agents or attorneys to represent them before the commission.

Mr. A. A. Godard, of Topeka, Kan., reported that the legislative committee, of which he was a member, had drafted a bill to be presented to various Legislatures in relation to the regulation and control of telephone companies by public-service commissions. This bill will be printed and distributed by the secretary.

A communication from Mr. W. F. Goodrich, of La Crosse, Wis., in relation to the working of the public-service commission in that State, was received and extracts from it were read. A gentleman from Mississippi told of the work of the railroad and telephone commission in that State. In one case where the Bell company gave free service as a competitive measure the commission made the company take out its free telephones. However, the Bell company is allowed to meet competitive rates, although the law says that telephone rates should be the same in towns of the same size throughout the State of Mississippi. There is no minimum rate; the telephone companies can charge as little as they like, and in one case a system with twenty miles of line gives service for $5 a year.

One Ohio delegate opposed the plan of compulsory nondiscriminatory physical connections under the supervision of the State commissioners. This gentleman remarked that in a given territory the Bell company might give very good service with the help of outside experts and then discontent Independent subscribers, getting them to change companies, explaining that the few Independents left could be reached over the trunk lines between the competing exchanges.

On the recommendation of Mr. Melchers, chairman of the committee on nominations, the association elected the following directors: Frank H. Woods, Lincoln, Neb.; E. B. Fisher, Grand Rapids, Mich.; B. G. Hubbell, Buffalo, N. Y.; H. D. Critchfield, Chicago, Ill.; S. E. Ward, Mansfield, Ohio; L. D. Kellogg, Chicago, Ill.; F. N. Kondolf, Rochester, N. Y.; Richard Valentine, Janesville, Wis.; E. H. Moulton, Minneapolis, Minn.; Theodore Gary, Macon, Mo.; Walter J. Uhl, Logansport, Ind.; Manford Savage, Champaign, Ill.; A. E. Boqua, Fort Smith, Ark.; J. C. Casler, Dallas, Tex.; E. D. Schade, Johnstown, Pa.; W. J. Melchers, Alma, Mich.; N. G. Hunter, Wabash, Ind. These directors will appoint the officers of the association.

After making some amendments to the by-laws so as to allow small companies in states having no state organizations to vote in the national association, the convention was adjourned.

TECHNICAL AND OPERATING CONFERENCE.

While the great interest of the convention centered on matters of public policy, several sessions of a "technical and operating conference" were also held under the chairmanship of Mr. L. E. Hurtz, of Lincoln, Neb. The first paper presented, on Wednesday afternoon, was a long and scholarly production by Mr. W. D. Kerr, of Chicago, who is a counselor on public-service problems. His subject was "Public Relations of Telephone Companies," considered under several headings. While state commissions, he said, do not offer a conclusive solution of the public relations of public-service companies, they present the best way of meeting the situation now available. In the discussion, Mr. Folsom, of Circleville, Ohio, spoke of the diversity of telephone rates and the advantage of compiling compendiums of rates, say, by states. Mr. Johnson, of Colum-

bus, referred to the proposed State telephone commission of Ohio, previously mentioned in the *Electrical World*.

Mr. Hugh T. Wreaks, of the Wire Inspection Bureau of New York, read a paper on "Inspection of Telephone Wire," in which he made a plea for the proper specification and inspection of conductor wire. An abstract of this paper is presented elsewhere in this issue.

On Thursday morning, at another short technical session, Mr. B. F. Wasson, of Clinton, Ill., described his system of signals to be used by construction men in building pole lines and stringing wires. He has written a booklet on the subject, which on motion was approved by the association.

The question box was then taken up. Discussing "phantom" circuits, Mr. George K. Gann, of Lincoln, Neb., said that these circuits form one-third of the total circuits of the Independent telephone system of Lincoln. More satisfactory results are obtained by using "phantom" circuits than with physical circuits. Grounds on the physical circuits, however, usually put the phantoms out of service. Proper transposition does away with cross-talk. Ringing troubles caused by inserting the "phantom" coils in the physical circuits can be obviated by adjusting the relays and by other means. The efficiency of the physical circuit is slightly lessened after the coils are inserted, but not sufficiently to be a detriment. Ordinary lighting protection is used. The longest "phantom" circuit in the Lincoln territory is eighty-five miles, but it is practicable to have circuits of this character 500 miles or longer.

Another question related to maintenance expense per telephone. Mr. Glass, of Pekin, Ill., placed this figure at from $6.50 to $7.00 in small exchanges and at $9.00 for larger exchanges. These amounts include practically total operating expense, without interest on investment. Mr. Brown, of Abilene, Kan., put maintenance expense pure and simple at $2.02 per telephone, while the total operating expense was $8.30. Another figure given was $8.50 (not including interest and taxes) and this seemed to be about the average figure in exchanges of 1000 subscribers. Methods of advertising toll business were discussed briefly.

On Friday morning Mr. A. J. Shands, of St. Louis, read a paper on "Private Branch Exchange Traffic," advocating that private branch exchange operators be employed by the company instead of by the subscriber. A discussion followed.

Mr. George K. Gann, of Lincoln, Neb., read a paper on "Special and Emergency Long-Distance Traffic." Discussion on Mr. Gann's paper was cut short by the resumption of the general sessions. This was the last feature of the technical and operating conference.

Lease of Reclamation Dam Power Rights.

A bill is now before Congress amending the National Reclamation Act in order to permit of leasing rights to utilize power made available by irrigation dams. The proposed amendment reads as follows:

"That whenever a development of power is necessary for the irrigation of lands, under any project undertaken under the said reclamation act, or an opportunity is afforded for the development of power under any such project, the Secretary of the Interior is authorized to lease for a period not exceeding ten years, giving preference to municipal purposes, any surplus power or power privilege, and the money derived from such leases shall be covered into the reclamation fund and be placed to the credit of the project from which such power is derived: Provided, that no lease shall be made of such surplus power or power privileges as will impair the efficiency of the irrigation project: Provided, further, that the Secretary of the Interior is authorized to make such lease for a longer period, not exceeding forty years, with the approval of the Water Users' Association, or associations under any such project, organized in conformity with the rules and regulations prescribed by the Secretary of the Interior in pursuance of section 6 of the reclamation act, approved June 17, 1902."

The people of Texas, particularly of the upper Rio Grande valley, which is to be directly benefited by the Elephant Butte dam and reclamation project, are much interested in the proposed amendment. As soon as the amendment is passed by Congress a company with a capital stock of $3,000,000 will be formed to install a hydroelectric plant in connection with the Elephant Butte project and construct electric power transmission lines down the valley of the Rio Grande to El Paso and other towns.

Telephoning to a Moving Train.

Renewed experiments with telephoning to a moving train are to be tried by the Stratford-on-Avon & Midland Junction Railway in England, using the invention of Mr. H. V. Kramer, of Birmingham. The electromagnetic-induction principle will be used, coils of wire wound about the cars and in series with the train apparatus forming the primary winding of the open-core repeating coil, the secondary of which is a wire paralleling the rails on the ground and connected to the station instruments. Besides the advantages which travelers will enjoy of communicating with friends while the train is speeding, this use of the telephone for signaling and dispatching purposes is expected to result in increased safety of train operation.

Patent Court of Appeals.

A committee of the American Bar Association in an appeal for support of the bill now before Congress authorizing a Court of Patent Appeals, to be presided over by four judges assigned from among the federal judges by the Chief Justice of the Supreme Court and a presiding judge appointed by the President and confirmed by the Senate, cites several cases to illustrate some of the evils that the establishment of such a court would mitigate.

One great question relating to the effect and operation of the patent law which is open to-day is whether the owners of or licensees under different patents, controlling patented articles of similar use which would compete in the market, if such competition were unhindered—like sewing machines, or typewriters, or automobiles—can lawfully form a combination under the protection of their patents to uphold their prices. On this subject the Circuit Court of Appeals for the Third Circuit decided that they could not; that each patentee has his own monopoly of his own invention; but that two or more patentees cannot unite to form a new monopoly; that the public is entitled to the benefit of competition between articles covered by different patents as well as between different unpatented articles. On the other hand, the Circuit Court of Appeals for the Seventh Circuit has held in later cases that the anti-trust statute does not apply to patented articles and that patentees or licensees under different patents relating to the same thing have lawful right to combine to maintain prices as a result of the monopoly conferred by the statute. There is thus one rule of law binding upon the citizens of the Third Circuit, comprising the States of New Jersey, Pennsylvania and Delaware, and another rule of law binding upon the citizens of Indiana, Illinois and Wisconsin of the Seventh Circuit. What the law is in the other States of the Union no one knows.

Reference is made to a litigation involving a patent for an electric cigar lighter. Eldred sued Kessler for infringement of a patent on this device. The defendant prevailed in the Circuit Court of Appeals for the Seventh Circuit on an issue of non-infringement covering all the claims. The court held that the patent was one of narrow scope and that, being so construed, it was not infringed by the Kessler lighter. This decision was in 1900. Eldred then brought suit on the same patent in the Second Circuit against the user of a cigar lighter similar to the Kessler lighter, but made by another manufacturer. The Circuit Court of Appeals in that circuit construed the patent broadly enough to find infringement. This involved a square conflict between the Circuit Courts of Appeals of the Second

and Seventh Circuits. Eldred then began suit on the same patent against Breitwieser, who was a user of a Kessler lighter in the Western District of New York, got a preliminary injunction against him and sent out threats of suit against Kessler's customers elsewhere. Kessler then filed a bill against Eldred in the district of his residence to enjoin him from bringing or prosecuting suits against his (Kessler's) customers anywhere on account of the use of cigar lighters covered by the decree in the original suit, on the ground that as between them the question of infringement of the Eldred patent by the Kessler lighter was *res adjudicata* under the decision of the Circuit Court of Appeals for the Seventh Circuit. That case went to the Supreme Court of the United States, which held that Kessler was entitled to the injunction. Thus, if one buys a cigar lighter from Kessler in Illinois or anywhere else he may use it anywhere, even in the Second Circuit where the patent has been held valid. If one buys that cigar lighter from any other maker than Kessler, he may use it in the Seventh Circuit and not infringe; but if he brings it into the Second Circuit and uses it he at once infringes. If one makes such a lighter in the Second Circuit he infringes; but he may carry it into the Seventh Circuit and use it freely. If a user of such cigar lighters were sued in the Second Circuit by Eldred for infringement of his patent and an injunction asked, the court would have to exclude from its restriction (as was done in the case of Consolidated vs. Diamond) all lighters made by Kessler. What might happen in any one of the other seven circuits one may only surmise.

Another case cited relates to an improvement in washing machines. This patent was first held valid in the first suit brought upon it by the United States Circuit Court of Appeals for the Eighth Circuit. It was a highly useful invention and the defendant in that case, accepting the decision as establishing the validity of the patent, bought it from the patentee. But manufacturers in other parts of the country were so attracted by the utility of the device and so encouraged by the uncertainty of the finality of the decree in the Eighth Circuit that they took the chances of infringement. The purchaser of the patent happened to have the money and determination to stand up for his rights and brought suit against infringers in five different States, as follows: Two in Illinois, one in Wisconsin, two in New York, one in Missouri and one in Indiana. In five of these cases appeals were taken to Circuit Courts of Appeals. The litigation began Oct. 18, 1898, and ended with the decision of the Court of Appeals for the Seventh Circuit on March 18, 1909. In these various proceedings the time of twenty-one federal judges was occupied in sixteen contested hearings. The printed records and briefs contained in all 10,850 pages, and the total costs amounted to over $65,000. All this was to settle the rights of the patentee under a patent covering so little a thing as a part of a washing machine. And they have not been settled yet, except that infringers appear to have given up from mere discouragement. There is good reason to believe that if the appeal in the first suit had been to such a court as is proposed in this bill, having jurisdiction coextensive with the Union, its decision would have been acquiesced in everywhere without further contention.

The committee says that the worst effect of the existing situation is that it undermines confidence. It demoralizes the bar. A lawyer does not know how to advise his clients. It tempts both attorney and client to take chances. The law-abiding citizens who want to obey the law, who want to respect valid patents, but do not want to be terrorized into acquiescence in invalid patents, do not know what to do and cannot find out. There is, it concludes, but one remedy, and it is in a single court of last resort in patent cases. It is impracticable to throw this burden on the Supreme Court and the only wise alternative is to put such final jurisdiction in the hands of a single court equipped with judges of the highest qualifications attainable for the special work committed to them, and so organized that it will be adequate to the present business and capable of growth in the future by mere additions to the number of its judges.

Unified Electric Systems.

At a meeting of the American Institute of Electrical Engineers held on Feb. 10 in New York Mr. William B. Jackson, Chicago, presented a paper dealing with the advantages of unified electric systems covering large areas. The advantages resulting from serving any territory from a comprehensive transmission and distribution system as a substitute for disconnected central stations located in the cities and villages were summarized as follows: Saving in generating-station equipment made possible through taking advantage of the diversity of different communities by serving them from the same transmission system; lower generating cost per kw-hour due to larger plants and improved loading factor; less investment in plants per kilowatt rating on account of larger plants as compared with smaller; the possibility of decreased percentage of spare apparatus by appropriate arrangement of plants; saving in cost made possible by centralized management, general superintendence and other general expenses; the possibility of providing rural and suburban service that could not be profitably reached by a local central station; the possibility of large corporations providing service which would be too extensive for small companies to undertake; the development of water-powers for electric service.

Brief outlines were given of several representative systems now serving large territories. The system of the Pacific Gas & Electric Company, San Francisco, covers 12,000 sq. miles and supplies energy to 150 towns separated by as great a distance as 200 miles. The Southern California Edison Company's system covers about 1000 sq. miles. The Commonwealth Power Company and the Grand Rapids-Muskegon Power Company, in Michigan, serve twenty-five towns ranging in population from 90,000 to 112,000 inhabitants. The North Shore Electric Company, Chicago, serves a district covering 1200 sq. miles and containing sixty towns varying in population from 100 to 27,000. The system of the Eastern Michigan Edison Company covers about 900 sq. miles around Detroit, serving nineteen towns ranging from 150 to 19,000 inhabitants. The Edison Electric Illuminating Company of Boston serves a territory of about 625 sq. miles containing thirty-six towns ranging from 800 to 670,000 inhabitants. Other extensive systems are those of the Janesville Electric Company in Wisconsin, the Hudson River Electric Power Company in New York, the Southern Power Company in North and South Carolina, and the systems around Niagara Falls in Ontario and New York.

The author expressed the opinion that one of the most important advantages which a strong, unified and comprehensive electric system possesses over a number of small separate supply companies serving a territory lies in its ability to serve consumers profitably which the smaller companies are unable to serve. The advantages of the company with extended transmission lines are emphasized through the improvement of load-factor which may be accomplished when the requirements of several cities affording good winter loads are associated with the motor loads of industries which operate only in the summer.

Discussion.

Mr. Peter Junkersfeld, of the Commonwealth Edison Company, Chicago, said that in investigating the possibilities of extending a transmission and distribution system over a wide area it is necessary to consider the character of the territory to be served, the local cost of fuel, the design, construction and extension of the system and the management of the organization. In view of the fact that individual towns may either increase or decrease in population and prosperity, while a large group of scattered towns do not exhibit wide changes in population or prosperity, and such changes as do take place are almost invariably increases, it will be appreciated that a system covering an extended area including a large number of towns represents a much more stable investment than when confined to a single community and can be more readily financed.

Prof. W. L. Robb, of Rensselaer Polytechnic Institute, Troy, N. Y., expressed the opinion that a unified electrical system

represents a better economic undertaking in a territory containing numerous small scattered villages than in a territory where there are many large towns or cities. The local plants in cities can be run at a profit, but the villages are unable to operate separate plants without financial loss.

Mr. Frederick Darlington, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, stated that the item of obsolescence is of greater moment in small stations than in a unified system in which use is made of highly efficient large generating units. One of the operating advantages of the large system resides in the ability to maintain twenty-four-hour service and thus to sell energy for various purposes during the non-peak hours. Of the many non-peak loads that can be obtained one of the best is irrigation pumping, the daily and seasonal variation in which is well suited for combination with the lighting load.

Mr. George H. Lukes, of the North Shore Electric Company, Chicago, said that experience has proved that many small industries spring into existence along a system supplying twenty-four-hour service in towns where such industries would not have located if the electric service had not been available.

Mr. N. T. Wilcox, of the Lowell Electric Light Corporation, Lowell, Mass., claimed that in comparison with good management good engineering is much more important. Unsatisfactory management can easily be rectified at any time, but defective engineering can be remedied only at costs that are often prohibitive.

Mr. Philip Torchio, of the New York Edison Company, mentioned the fact that many of the economic losses which burden the small stations can be eliminated by combining the stations under one management and supplying energy from a unified system. The reserve equipment will be much smaller than the aggregate reserve equipment of the small stations, and even the maximum load on the unified system will be smaller than the sum of the maximums of the individual stations.

Mr. L. L. Elden, of the Edison Electric Illuminating Company of Boston, stated that in a certain system calculations had shown that the saving in installation cost was $125,000, due to unification of the small systems by reason of the diversity factor between the separate systems.

Dr. C. P. Steinmetz called attention to the fact that there is no limit to the extent to which unification of systems may be carried in that the larger the generating unit the more economical is the operation. Thus a 20,000-kw turbo-generator unit is more efficient that a similar unit of 14,000-kw rating, which in turn is more efficient than a 10,000-kw unit. He said that, although the fixation of nitrogen electrically from the air can be carried on intermittently, yet it is not at present economical to do so because of the large cost of equipment that would be idle at times. A more practicable scheme would be to combine fertilization by nitrogen with irrigation pumping to obtain simultaneously the best agricultural results and the most advantageous load on the electrical system.

The Pittsburgh Transit Problem.

Mr. Bion J. Arnold delivered an address on Wednesday, Feb. 8, before the Engineers' Society of Western Pennsylvania at Carnegie Library, Pittsburgh, on "Pittsburgh's Transit Problem." Mr. Arnold, who has been investigating the question of electric traction in the Pittsburgh district, discussed the matter at some length from the standpoint of an engineer. He gave many statistics to prove his conclusions and reminded his hearers that Pittsburgh is a district, not a city, and that the traction development should be worked out with this in view.

He showed that the population of the district is relatively scattered as compared with other cities and that the success of future rapid transit growth would be dependent on the growth in population. Statistics were given showing that the growth of Pittsburgh during the past two years had been large, and it was pointed out that the realty values along the line of the New York subway had increased more than 100 per cent beyond the normal rise.

The financial and operating records of the Pittsburgh Railways Company were analyzed in detail and compared with those of other cities. Mr. Arnold stated that in his opinion the methods available for permanent betterment of Pittsburgh's transit situation were a reduction in fixed charges, a temporary waiving of dividends, a reduction of operating costs by re-routing some of the lines and an increase in earnings by encouraging people to ride more. He urged the necessity of the railway company carrying out the recommendations which the State Railroad Commission made some months ago in regard to service, and also advocated the establishment of a public utility bureau for checking purposes. Mr. Arnold also advocated the increase of the bonding power of the city to enable the construction or the purchase of transit facilities by exempting self-supporting bonds from the debt limit.

In concluding his address Mr. Arnold predicted that the Pittsburgh district, now comprising about 1,000,000 people, will probably double its population within the next thirty years and that within this time the earnings from transportation will increase from $10,000,000 to $40,000,000, which increase would justify a future expenditure of $150,000,000 for proper transit facilities.

Mayor William A. Magee, who has for some time past actively engaged in the solution of the transit situation, preceded Mr. Arnold with a short address in which he advocated the formation of a board of impartial, capable men to arbitrate the questions arising between the city and the railways company. The Mayor did not express any definite ideas as to the powers of the board or its selection.

Tests for Insulated Copper Wire.

At the convention of the National Independent Telephone Association held in Chicago, Feb. 8-10, Mr. Hugh T. Wreaks, secretary of the Wire Inspection Bureau of New York, read a paper on "Wire Inspection." Although the talk was addressed specifically to telephone engineers, much of the information contained is applicable to electric lighting companies. The author enumerated some of the tests, explaining what they meant and how they could be interpreted. For convenience these tests were grouped as follows: Braid, ordinary-grade rubber insulation, high-grade rubber insulation, soft-drawn copper wire, hard-drawn copper wire, tinning, copper-steel wire, galvanized-iron wire and lead-covered paper cables.

Mr. Wreaks pointed out that the function of the braid is to add strength to the wire and to serve as a protector to and prevent the action of air on the compound or conductors underneath. Rubber insulation, both low and high grade, has been in the past, and is even now to a greater or less extent, a bone of contention between purchasing agents and wire manufacturers. The characteristics of a good compound are high insulating qualities, long life, both physical and electrical, and sufficient strength to withstand without damage such handling as it will receive when being installed. The quality of strength is not so important, especially when the insulation is covered by a braid. There are, however, many engineers who claim that a relation exists between electrical, physical and aging qualities of a rubber insulation, but the author stated that the Wire Inspection Bureau had made a number of experiments along these lines without discovering any such relation.

For making electrical tests on rubber insulation it is necessary to install large water tanks, together with the necessary cranes and other apparatus for handling the coils and putting them in and removing them from the water, as all electrical tests on rubber compounds are made on coils immersed in water. Transformers capable of giving at least 3000 volts, and preferably 10,000 volts, are needed, together with switchboards and the necessary apparatus for the purpose of applying the voltages required to locate the weak spots, which either

show up immediately or are observed when the insulating resistance is taken. The latter treatment requires a sensitive galvanometer mounted so as to be free from vibration, together with necessary scale, telescope, shunt and high-resistance batteries.

The physical tests on ordinary-grade insulation were classified under three heads: Hardness, flexibility and softness. The test for hardness requires no apparatus except a sharp knife and a little practice, and consists in carefully removing the braid and then wrapping the insulation on itself and seeing that no cracks develop in less than twenty-four hours' time. The test for flexibility consists in wrapping the insulated and braided wire under tension around a small mandrel immersed in water and measuring by electric tests the damage, if any, that has been done. Tests for softness are made directly on the insulation and, by means of an electric current and a scale, tell how many pounds' pressure it takes for a given tool edge to cut through the insulation. Physical tests on high-grade insulation are usually of the nature of a stretch-and-return test, say, from 2 in. to 6 in. and return in one minute to 2¼ in., then a stretch without breaking to 9 in. The tests also call for a breaking strain of about 800 lb. per square inch. Specifications for high-grade rubber insulation generally call for chemical tests, which are more or less of the nature of identification tests. They also serve a useful purpose, but as yet no chemical test of value has been developed for ordinary-grade rubber compounds.

Tests for both soft-drawn and hard-drawn copper wire are in the main alike in kind, but different in degree, elongation tests and breaking-strength tests being called for for both, and a twisting test being called for for soft copper. Hard copper, again, must be carefully observed for splinters since these are very dangerous to the linemen in handling the wire. In making tests for strength and elongation a tensile machine is required, which for hard-drawn wire has to register quite a high breaking strain. Physical tests on soft-drawn wire, except in large sizes, need only simple apparatus. Conductivity tests are also specified for both soft-drawn and hard-drawn wire, although for the former they are of less importance as practically all copper when soft has a conductivity above specifications. When hardened through annealing, baser metals may be used which may appreciably lower the conductivity. The resistance of the copper is, of course, important and is included in conductivity measurements, the two together helping to check up the lengths of the coils and the amount of a given order. The quantity of copper cannot be determined without a knowledge of its cross-section, and measurements with micrometer calipers are necessary. These measurements are also essential in checking up insulations and braids.

Tinning on wire is put on not only to preserve the copper presumably against any action from free sulphur or oxidizing agent in the rubber compound, but also to protect the copper from the air in case the braid or compound on the wire is damaged in spots. This latter occurrence is, however, not anticipated and will require a tinning much heavier than is generally used. In tinning copper wire the tin must be put on before the wire is insulated and must, therefore, form a flexible coating and one not likely to be damaged in handling and in the insulating process itself. Too thick a coating of tin would obviously be apt to chip off in this handling. A chemical test for tinning is made by alternate immersions in a solution of hydrochloric acid and a solution of sodium sulphate of stated strength and for stated periods of time. Another test specified is to band the wire around a given mandrel, depending upon the size of the wire, and then immerse the wire in the sodium solution for stated intervals. Both of these tests must be made with care, since otherwise the exposed copper ends of tested metals will affect the test and possibly the solution. These tests are empirical in their nature and are what might be termed factor or safety tests, being more severe than are generally made in practice. The experience of the author fails to show any corrosive action due to oxidizing agents in the insulation. Other points of wire and cable inspection covered by the author had to do specifically with telephone work.

Light and Architecture.

Following a highly enjoyable beefsteak dinner served in the Dungeon of the Castle Cave, New York, on the evening of Feb. 9, the New York Section of the Illuminating Engineering Society held its regular monthly meeting, which was devoted to a discussion of architecture and illumination. The discussion was opened by Mr. Henry Hornbostel, who outlined the conditions leading to the installation of the artistic luminous ceiling over the auditorium in the Allegheny County Soldiers' Memorial Building, Pittsburgh. He claimed that the lighting units now available offer almost unlimited possibilities for the use of light of different colors in the decorative illumination of interiors. He expressed the opinion that the time is not far distant when the present types of lighting fixtures will be superseded by fixtures of the completely illuminated type or be abandoned in favor of luminous ceilings.

Mr. Donn Barber remarked that it behooves those dealing with illuminating problems to recognize the rapid advances being made in the art and arrange all present installations with this fact clearly in mind.

Mr. S. F. Voris stated that the architect will be much benefited by consultation with the illuminating engineer concerning the engineering features of illuminating problems.

Mr. Bassett Jones, Jr., explained the relation which should exist between the illuminating engineer and architect by stating that it is the duty of the illuminating engineer to specify the lighting equipment and arrangement which should be employed to obtain the results desired by the architect to correspond to the plan which he has conceived for the interior considered as a whole. Many of the lighting problems, such as those relating to factories, stores, etc., can safely be left to the illuminating engineer, but the architect is needed when dealing with interiors where artistic effects are desired.

Mr. V. R. Lansingh claimed that, although the first requirement imposed upon the illuminating engineer is to obtain exactly the results desired by the architect, yet of almost equal importance is the obtaining of these results at the minimum cost. Although efficiency is of small moment in many lighting installations, yet efficacy and economy are of importance in all.

Mr. D. McFarlan Moore said that well-distributed large-surface sources of illumination are far preferable in many cases to distributed point sources. By employing glass-tube lamps with the proper gases for the conducting column there may be obtained a wide variety of different colored lighting units for all artistic purposes.

Widening Scope of Electrical Activities.

The new officers of the Chicago Electric Club conducted the regular meeting at noon, Feb. 8, at the Kuntz-Remmler restaurant, with Mr. Homer Niesz in the chair. The secretary, Mr. N. S. Obright, announced the appointment of chairmen of various committees as follows: Speakers committee, Mr. C. A. Howe; membership committee, Mr. George H. Jones; house committee, Mr. A. L. Millard; entertainment committee, Mr H. A. Mott; finance committee, Mr. W. R. Bonham; civic committee, Mr. J. W. Mabbs. These chairmen are to appoint the other members of their committees. Mr. Frederick J. Pearson, chairman of the Chicago Section of the Illuminating Engineering Society, spoke on the prospect of having the next convention of that society at Chicago and urged that the Electric Club send an invitation to the council of the society to ratify and strengthen other invitations which had been given to hold the convention at Chicago, probably in September. Upon motion of Mr. Vose the officers were instructed to send a telegram of invitation to the council of the Illuminating Engineering Society.

The speaker of the day was Mr. Albert Scheible, research engineer, who spoke on "The Widening Scope of Electrical Activities." Mr. Scheible reviewed in a very concise way the

newer uses of electricity, which are continually widening. He introduced his remarks by saying that men were paying the penalty of super-specialization by knowing but little about what was going on in fields other than the ones in which they were particularly interested. One result of this had been a duplication of research work by manufacturers in attempting to develop new appliances and methods. The purpose of the research engineer as compared with the ordinary consulting engineer is to tell manufacturers what has been done abroad and at home along the same lines and so avoid needless expenditure. As an example of the necessity for this he referred to the case of a porcelain manufacturer a few years ago who discovered that porcelain is an electrical conductor when red hot. This manufacturer had great plans for making use of this property of porcelain until Mr. Scheible told him that he had simply rediscovered the principle of the Nernst lamp, which principle was already in extensive use. Mr. Scheible's talk was full of specific illustration of the general points which he made and described many ingenious and interesting devices. Among these was a process for rendering opaque drawing paper translucent like tracing paper, so as to do away with the necessity of making tracings. The drawings are run through a hot wax bath, then between electrically heated rollers and in a short time come out translucent and ready for the making of blueprints, thus doing away with the expense and room occupied by boys and men employed for tracing the original drawings. He referred to the method of location of underground pipes by induction coils and the steering of torpedo boats by wireless. With the increase of methods of electric communication secrecy is becoming more difficult. The overthrow of the Portuguese government was announced to the world instantly by wireless, although cablegrams were censored. He spoke at some length on opaqueness and translucency of various substances to light and to electromagnetic and electrostatic waves.

Methods used for detection of ore, coal or water in underground deposits were touched upon. In sanitation and ventilation electricity furnishes means for air moving by fans or air purifying by ozone, for air heating and for air cooling. When used in cooking it affords definite results as against the uncertainty of flame sources.

Mr. E. L. Elliott, of New York, being present, was called upon and spoke a few words on the tremendous possibilities for improvement in the efficiency of light production. At the present time about 5 per cent is the highest efficiency obtained in practice.

New York Commission News.

The Public Service Commission, Second District, has served upon the Binghamton Telephone Company the complaint of Frank P. Mitchell, of Binghamton, alleging that the rates charged by that company are in excess of the provisions of the franchise under which the company is now operating. Under the franchise it was provided that the charge for business purposes should be $30 per annum and for private dwellings $15 per annum. The new schedule of rates put into effect provides for a charge of from $18 to $30 for residential service and from $36 to $48 for business service. The company has been required to answer the complaint within twenty days.

The commission has served upon the Hudson Counties Gas & Electric Light Company a complaint of the Board of Trustees of the village of Cornwall, County of Orange, alleging that the lamp service is below standard, the power insufficient and the rate of $20 for a 25-cp street lamp unreasonable and beyond what the taxpayers should pay, such rate including a profit in excess of a fair return upon the money actually invested in its business in the village of Cornwall. The company has been required to answer the complaint within twenty days.

During the present week the New York City Commission will hold hearings on the application of the Kings County Lighting Company for approval of a sliding scale for gas rates; on a complaint against the Queens Borough Gas & Electric Company as to rates for gas and on a complaint against the same company as to rates for electricity.

The Public Service Commission, Second District, has received complaints from the Boards of Trade of the villages of Lake Placid, Saranac Lake and Tupper Lake directed against the Western Union Telegraph Company, the Great Northwestern Telegraph Company of Canada, the Postal Telegraph Company and the Champlain Telegraph Company as to alleged unreasonable telegraph rates charged from these places. It is shown that the rates complained of are greater than from other places within a short distance of these points. The rate to New York is 50 cents, while from Malone, Plattsburgh, Potsdam and other points in Franklin, St. Lawrence, Lewis, Jefferson and Essex Counties the rate to New York is 35 cents. The rate to Carthage is 60 cents and from Westport to Carthage is but 35 cents. To Alexandria Bay the rate is 50 cents, and from Westport to Alexandria Bay it is 35 cents. To Syracuse the rate is 50 cents, and from Canton to Syracuse 35 cents. To Buffalo the rate is 50 cents, and from Elizabethtown to Buffalo 35 cents. To Albany the rate is 50 cents, and from Elizabethtown to Albany 35 cents. The commission is asked to make an investigation and fix just and reasonable rates between the points of complaint and other points in the State of New York. The company is given twenty days to answer the complaints.

As a result of an investigation and proceedings before the Public Service Commission, Second District, the village of Fort Edward has secured a reduction in the price of street arc lights from $80 per lamp to $63.87 per lamp per year. The village of South Glens Falls has also secured a reduction in the price per arc lamp from $72 to $63.87 per year. The Hudson River Electric Company secured a franchise and contract in South Glens Falls for furnishing street lighting. The United Gas, Electric Light & Fuel Company, of Hudson Falls, has for a term of years furnished street lighting for the village and vigorously opposed allowing a competing company to come into that small field. After investigation the commission advised the United company that it should reduce the price of street lighting to $63.87 per lamp, and if such an agreement were made it would deny the application of the Hudson River company to enter its field. A stipulation granting the reduced rate has been made.

Citizens of Fort Edward had also complained of the price of street lighting in that village, and the commission caused an investigation of this complaint to be made and advised the United Gas, Electric Light & Fuel Company, which also operates in Fort Edward, that it believed it should reduce its price from $80 to $63.87 per lamp, and this has also been agreed to. The two villages have approximately 100 street lights of 2000 cp in use.

Massachusetts Commission News.

The Massachusetts Highway Commission has approved the addition of certain new telephone rates by the New England Telephone & Telegraph Company to the schedules placed in service by the board about four months ago for the Boston and suburban district. The schedules laid down by the board, according to the views of the company, offer at equitable rates sufficient and suitable classes of service to meet the varying legitimate requirements of all subscribers, with one possible exception, in the Boston district. The company feels, however, that although the district or zone service of the new schedule is apparently better adapted to the needs of the majority of the subscribers, there are nevertheless a very substantial number of residence subscribers who have little use for residence service, but who, on the other hand, have one or two exchanges outside their local district which for social or family reasons they have been in the habit of calling in the past with more or less frequency. The company informed the commission that a

substantial number of these subscribers, unless they curtail the use of their trans-suburban calls, will have the cost of their residence service materially increased. The company points out that no four-party line unlimited service, in a rapidly growing multi-exchange territory, such as the suburbs of Boston, no matter how remunerative to the company, can be permanently retained in the schedule without distinct unfairness to the rest of the subscribers. The company, therefore, submitted to the board a tentative offer of one-party and two-party line unlimited suburban service at the rates of $45 and $36 per year, this being a reduction from the original rates of $54 and $42 per year in force in the district prior to the institution of the zone rates. The commission's approval of these additional rates places at the disposal of the suburban patron making use of them the opportunity to call forty-four different exchanges, covering an area of about 400 sq. miles, without extra charge, and affords the public probably the most liberal metropolitan telephone facilities in the world.

The Massachusetts Gas & Electric Light Commission gave a hearing at Worcester on Feb. 9 upon the appeal of the Worcester Electric Light Company against a grant by the municipal authorities to Mr. A. S. Lowell of the right to lay a conduit and transmit electricity across Foster street between two branches of his mercantile establishment. The company was represented by its counsel, Mr. Everett W. Burdett, of Boston; President George T. Dewey, and other officials. Mr. Charles M. Thayer conducted the case for the respondent and contended that the intention was simply to transmit electricity diagonally across the street from an isolated plant owned by his client to a large retail store at present lighted by the central-station company and by the local gas-light service. Evidence was introduced to the effect that there was no intention of selling electricity on the block plant basis. For the company Mr. Burdett pointed out that the whole trend of the State's policy had been to prohibit the transmission of electricity across public thoroughfares, and he cited several decisions of the commission to that effect. He argued that if one person should be granted the right to transmit electricity under, over or across the public ways there would be no proper reason why others should not be given the same privilege, and the result might easily be the improper extension of isolated plant competition throughout an entire business center, with much needless duplication of plant and equipment and a general demoralization of the central-station commercial field. The board took the matter under advisement.

In connection with the petition of Mayor Logan for reduced street-lighting prices in Worcester the next hearing date has been changed to Feb. 27, at Worcester, when Mr. William D. Marks, consulting engineer for the city, will be cross-examined by counsel for the Worcester Electric Light Company.

A hearing was given last week by the legislative public utility committee upon the plan of Governor Foss to abolish the present State commissions and create two new public service commissions, one having jurisdiction in Greater Boston and the other outside. Secretary Travis S. Whitney, of the Public Service Commission, Second District, New York, was present by request and explained the features of the New York regulative tribunal and laws. So far as New York conditions went he was convinced that the abolition of the old methods was a good procedure. He admitted that comparisons between the New York and Massachusetts systems were difficult to make in view of the fact that public-service corporations have been gradually improving under Massachusetts supervision for a long period, while little supervision existed in New York three years ago. Mayor Fitzgerald, of Boston, appeared on behalf of the bill to establish two new tribunals. There appears to be little prospect that the present commission system will be altered in Massachusetts, evidence of the necessity of such a change having been conspicuously absent in discussions of the matter.

The Boston & Worcester Street Railway Company has petitioned the Railroad Commission for authority to issue additional capital stock to the amount of $437,000 to meet the cost of improvements.

Wisconsin Commission News.

The commission has authorized the Durand Light & Power Company to put into effect a new schedule of rates for commercial lighting which will result in a material increase in revenues. The present rate of 6 cents per kw-hour, it was alleged, did not furnish sufficient revenue to keep the plant and system in an efficient condition, nor did it make distinction between the different classes of consumers.

The plant is a water-power development, and it was shown in the investigation that the yearly operating expenses were considerably below the average for plants of the same size under similar conditions. Seventeen plants in Wisconsin gave an average of $23.62 per consumer per year, $27.89 per kilowatt of generator capacity, and $23.61 per kilowatt of connected load. The expense per kilowatt of connected load for Durand was but $14.84 for the year 1910. From an analysis of the commercial lighting costs the following schedule of unit costs was arrived at: One hour's daily use of the active connected load, 12.2 cents; two hours' daily use, 7.54 cents; three hours' daily use, 5.99 cents, etc. On this basis the commission suggested that a rate of 12.2 cents per kw-hour for the first thirty hours' use per month of the active connected load, 6.8 cents for the next sixty hours, and 4.5 cents for all above ninety hours would be an equitable schedule. It was found that this schedule gave about the same total results as the one applied for and which was granted by the commission. This schedule is as follows: For business houses, a charge of 15 cents per month per active 50-watt carbon or per 40-watt tungsten lamp, when the active load constitutes 60 per cent of the connected load, plus 4 cents per kw-hour for the energy used. For occasional users a rate of 12 cents per kw-hour may be granted. For residences, churches, halls, etc., a charge of 15 cents per month per active unit, when 35 per cent of the connected load is considered active, plus 4 cents per kw-hour for the energy used.

The increased revenues under the new schedule will amount to about 1.5 per cent on the total plant valuation and must be borne chiefly by the short-hour users.

The plant carries an unusually high power load by reason of the fact that several large mills are operated by electric power supplied by the company. The commission called special attention to the fact, brought out by the detailed cost analyses, that at the present contract rate given to the larger power users these cost the plant, on the basis of three hours' use per day, about four times as much as they pay, while on the basis of seven hours' consumption they cost about three times as much as they pay.

The town of Weyanwega and the Weyanwega Electric Company having failed to reach any agreement concerning rates for street lighting have appealed to the commission for an opinion and have agreed to abide by such opinion. A representative of the commission has been sent to Campbellsport to adjust differences regarding the rate to be paid for electric energy by the village of Lamira. The village, which is located about ten miles from the plant of the Campbellsport Electric Company, desires to obtain energy from that company, but at a lower rate than the company is willing to make

That the Railroad Commission has the power to abrogate a contract entered into in the form of a franchise granted by a city to a public-service corporation, and may render null and void the provisions of that franchise, is the text of a decision handed down recently by the Supreme Court in the case of the City of Manitowoc against the Manitowoc & Northern Traction Company. The decision is of far-reaching effect, for it means that no franchise now in effect has the force of a binding contract between the parties thereto, provided the commission sees fit to step in and alter any provisions in the franchise. The question came to the Supreme Court on an appeal from the Circuit Court of Manitowoc County where the trial court refused to make permanent a temporary injunction against the railway company, restraining it from raising the rate of fare between Manitowoc and Two Rivers from 10 cents to 15 cents. The franchise states that 10 cents shall be the maximum fare

between the two cities. All contracts will remain in force until the rates provided therein have been changed by the commission. If the rate is changed the contract is superseded. As the Manitowoc company has failed to bring the matter before the commission for a determination as to the reasonableness of the new rates the old rate must hold until such action has formally been taken and the new rate approved.

By handing down a decision that the indeterminate-permit clause of the Wisconsin public utilities law is legal, the State Supreme Court has upheld one of the most important powers possessed by the commission. The case was brought up by the Kenosha Electric Railway Company, which contended that a certificate of public convenience and necessity from the commission need not accompany a franchise secured from the City Council. The company furnishing lighting for the City of Kenosha recently surrendered its franchise and took an indeterminate permit. Shortly after this the railway company obtained a lighting franchise from the City Council, but did not apply to the railroad commission for a certificate of convenience and necessity. The lighting company prevented the railway company from carrying out the provisions of its franchise by instituting *in quo warranto* proceedings, which resulted in the railway company's appealing to the courts on the ground that the law was void. The Supreme Court has also held that the city ordinance of Milwaukee requiring that the street-car company sprinkle the pavement between its tracks and 1 ft. on each side is valid.

A decision in the matter of the complaint of the City of Sheboygan against the Sheboygan Railway & Electric Company, involving the rate and quality of service for street lighting, has been handed down recently by the Rate Commission. The city alleged that the company had failed to carry out the provisions of the street-lighting contract and had failed to furnish lamps of as high a candle-power as was provided for in the contract. The old contract called for an arc lamp of "full 2000 cp," for which payment was to be made at the rate of $74 per year. One year before the present contract was drawn up the company changed its equipment from the direct-current open arc to the 7.5-amp inclosed series alternating arc, but no reference is made in either contract to the type of lamp to be used. The latest contract expired in September, 1910, and the company has since been furnishing light for which the city is willing to pay, but not at the rate of $74 per annum as fixed by the expired contract.

In its testimony the company claimed that the cost of lighting the streets of Sheboygan is much in excess of the revenue derived therefrom when the service is charged with its proper share of the total expenses, but that the company was able to carry the street-lighting business at an apparent loss because a considerable portion of the fixed expenses now being charged to street lighting would still continue should the company cease to furnish the service. When the affairs of the company were analyzed the commission failed to find that any such conditions existed. Whereas the company claimed a total investment of $57,536 chargeable to street lighting, and an annual expense for this branch of the service of $20,796, the values as determined by the commission were $38,900 and $13,196 respectively. This corresponds to a yearly cost per lamp of $107 according to the company's figures and $68.38 according to the figures of the commission. In arriving at these values the commission allowed 12½ per cent for engineering, legal expenses, contingencies, etc.; 4.7 per cent for depreciation, and 8 per cent for interest. These percentages are the ones usually used by the commission. As a result of this determination the commission ordered that the rate for street-lighting service should not exceed $68 per lamp per annum.

The commission noted the fact that the plant as a whole was earning less than 2 per cent on the cost of reproduction and that this was due to the fact that the expenses of the street-railway department were all out of proportion to the earnings; in other words, that the street-railway service is being furnished at less than cost. In this connection the commission states that it does not consider it good policy for the losses in one department to be made up from the surplus earnings of the other departments, but that each branch of the service should be self-sustaining. However, the point is made that there possibly are conditions under which, for social and economic reasons, it might be good policy for a city or community to depart, at least temporarily, from this rule.

With regard to the meaning of the term "2000 cp" appearing in the contract the commission cited numerous authorities throughout the country and quoted from the results of the Colorado Springs controversy.

In order to determine the quality of service rendered by the respondent company the engineers of the commission made a rather extended series of tests on from nineteen to fifty-two lamps in the City of Sheboygan. These results were compared with the results of tests made, under similar conditions, upon forty-seven lamps in other cities where the same type of lamp was being used, giving satisfactory service. These observations covered in general such matters as power consumption between lamp terminals, power consumption per lamp as measured at the power plant, lamp voltage, circuit current, candle-power of the lamp at an angle of 45 deg. below the horizontal and measurements of illumination produced. From the wattage tests it was found that the average power taken per lamp in Sheboygan was 430 watts, whereas similar measurements in the other cities investigated gave an average of 474 watts. The latter value approximates the normal value for this type of lamp of 480 watts between lamp terminals, and the lamps in Sheboygan fall short by about 10 per cent. The average candle-power, at 45 deg. below the horizontal, as determined by tests made upon fifty-two lamps in Sheboygan, was 210, while the results of forty-seven tests made in the other cities gave an average of 292. The average illumination falling upon a vertical plane 50 ft. distant from a point beneath the lamp, was 0.068 ft.-candle and 0.083 ft-candle respectively.

The comparisons clearly indicate that the service rendered by the respondent company was not satisfactory and that the equipment is not being used to render a fully normal service. The commission stated that the reasons for the poor service were to be found very largely in the company's method of lamp adjustment, in the behavior of the arc regulators, which are not being operated under the conditions recommended by the manufacturer, in instrument errors, etc. The company was ordered to improve its service and to make the same reasonably adequate.

By virtue of a decision in the case of the City of Neenah against the Wisconsin Light, Heat & Traction Company and the Wisconsin Electric Railway Company, recently handed down by the commission, the respondent companies are ordered, within twenty days, to grant a 5-cent fare with transfer privileges between the two systems within the city limits in substitution for the fare of 5 cents now charged by each road for travel within the corporate limits. Both companies operate interurban lines between Neenah and Manasha, but the Wisconsin Electric Railway Company is the only one whose lines traverse the City of Neenah from one end of the city to the other. The Wisconsin Light, Heat & Traction Company's lines extend but a short distance within the city limits.

It has hitherto been necessary to pay a fare of 5 cents on each road, and the city contended that the double fare was inequitable and not conducive to the best interests of the city. The respondents contended that the bulk of their business was between the Cities of Neenah and Menasha and that the strictly city business within the corporate limits of Neenah did not justify the joint fare; also that their franchises called for fares not lower than 5 cents within the city limits. The commission found that the city business did warrant a joint fare and the franchise objection was overruled on the authority of the recent Supreme Court decision in which it was held that the commission had the power to abrogate the contract rights of a franchise in respect to rates when such rates are placed in dispute before the commission.

CURRENT NEWS AND NOTES.

Electrical Expansion in Turkey.—It is reported that the Minister of Public Works of Turkey has invited bids for electric street railways in the cities of Adana and Adrianople and for the distribution of electric energy in the provinces of the same name.

National Dinner and Rejuvenation of the Sons of Jove.—The Sons of Jove will hold a national dinner and rejuvenation at Coney Island, N. Y., on June 2. The time and place have been chosen to accommodate the large number of electrical men who will attend the convention of the National Electric Light Association in New York during that week.

Hydroelectric Energy for Brazilian Mines.—Right to develop the Falls of Bracuhy, in Angora dos Reis, Brazil, has been granted by the Brazilian government to the Bracuhy Falls & Metallurgical Syndicate, which will utilize this hydroelectric energy in the operation of mines and iron-refining processes. Without storage the water-power is said to have a capacity of 24,000 hp and with dams 100,000 hp.

Gas Explosion Near Elgin, Ill.—Two men were killed and fourteen were injured seriously by a gas explosion in a house in Carpentersville, near Elgin, Ill., on Feb. 6. A gas main in the basement had been leaking for several hours, and a number of men were trying to repair the leak when the explosion took place. One of the men killed was employed by the Western United Gas & Electric Company, of Aurora, Ill.

Examination for Electrician.—The United States Civil Service Commission will hold an examination March 8 to fill a vacancy in the position of electrician in the Bureau of Standards at $900 per annum, experience in storage-battery work being a qualification. Further information, including list of places where the examination will be held, may be obtained by addressing the commission at Washington, D. C., referring to Circular No. 172.

Electric Vehicle Committee of N. E. L. A.—A meeting of the committee on electric vehicles of the National Electric Light Association was held at the University Club, Chicago, on Feb. 9. The members present were: Messrs. J. T. Hutchings, Rochester, N. Y., chairman; C. E. Michel, St. Louis; George Harvey Jones, Chicago; P. D. Wagoner, Long Island City; W. G. Bee, Orange, N. J., and F. M. Tait, Dayton, Ohio. The committee considered its report to be made at the coming New York convention. It will hold two more meetings, probably, before completing the report. After adjournment the committeemen inspected the Chicago Commercial Vehicle Show at the Coliseum.

George Washington Memorial Building.—The George Washington Memorial Association is starting a campaign to erect at Washington by popular subscription a memorial building to George Washington which will contain auditoriums for the meeting of patriotic, scientific and other societies of national scope, and provide a home for such scientific, educational and similar organizations as may make Washington their headquarters. Among members of the advisory committee are Hon. Elihu Root and Dr. Ira Remsen, of Johns Hopkins University. Further particulars may be obtained from the publicity bureau of the association, Demarest, N. J.

Train Dispatching by Telephones.—Complete telephonic train-dispatching equipment is now in use on the Dunkirk & Allegheny Valley division of the Lake Shore & Michigan Southern Railroad between Dunkirk, N. Y., and Titusville, Pa. Twenty-six telephone stations are in use on this division, with a selective call system, so that only the station wanted receives the call. These stations are established in all of the towns upon the line and all of the principal sidings where trains meet. The greater part of the train dispatching is now done by the use of the telephone system. The telegraph instruments have not been removed, however, and probably will be retained, as it is the intention to supplement rather than supersede them by the telephones.

Contest Over Truckee River Power Right.—The California Legislature, now in session, has passed a resolution requesting President Taft not to approve the proposed contract by which the government is to give the Truckee River General Electric Company a perpetual right to divert the waters of Lake Tahoe into Nevada. The resolution passed by the California Legislature declares that the lake and its watershed lie chiefly in California, and that the natural outlet of Lake Tahoe is the Truckee River in California, through which the overflow waters of the lake flow for over thirty-five miles through that State; that this river is a source of wealth to the State amounting to millions of dollars, and that the diversion would do great damage to California in depriving it of waters that can be used for irrigation and for power purposes.

Tungsten Production in 1909.—Advance figures from the Geological Survey publications indicate that the 1909 production of tungsten reached 5289 short tons of concentrates containing 60 per cent of tungsten trioxide, compared with 3898 tons in 1908 and 6062 tons in 1907. In very few of the returns, however, is the percentage indicated, which is necessary in comparing figures. It is probable that most of the exported ore is richer than 60 per cent in tungsten trioxide, and that the figures are therefore low. The principal sources of the 1909 production were: United States, 1619 tons; Argentina, 900 tons; Australia, 1200 tons; Bolivia, 168 tons; Germany, 106 tons; Portugal, 609 tons, and the United Kingdom, 421 tons. The value of the tungsten ore produced in the United States during 1909 was $614,370, compared with $229,955 in 1908 and $890,048 in 1907. With the recovery of the American steel trade during 1909 prices rose above those of 1908 and ranged from $5 to $9 per unit for tungsten ores, the average price being $6 to $6.50 per unit. Tantalum incandescent electric lamps have such strong competition in tungsten lamps that the demand for tantalum minerals seems rather to have decreased than grown. The tantalum used in this country in 1909 was imported from Germany.

Motor Advertising Penetrates Prison Walls.—An interesting example of the varied and extensive circulation attained by advertisements of the large electric manufacturing companies is well illustrated in the following incident which recently occurred in the upper portion of New York State. A letter was received by one of the manufacturing companies written on the stationery of a local hotel inquiring as to the use of a small motor for laundry work and mentioning an advertisement that had recently appeared in one of the magazines. A motor salesman was immediately dispatched to the town whence the inquiry came. He went to the manager of the lighting company and asked if he had any knowledge of the person making the inquiry. The manager had never heard of him, but suggested that the salesman go to the hotel from which the stationery originated and see if he could find any trace of the writer. The hotel manager pleaded ignorance of any such man at first, but on further questioning of the employees his identity was revealed. It was found that the man was an inmate in the State prison located in the town and worked in the prison laundry. A conversation with the warden of the prison confirmed this fact, and it was stated that the man was much interested in his work, had seen the advertisement and wanted to get the authorities interested in the purchase of a motor to run some of the washing machines.

Electric Iron Smelting.—Four additional electric iron smelters are being installed at Heroult, Cal. The original furnace has been in constant operation for some time, producing steadily about 20 tons of pig iron every day.

Colorado Electric Club.—Judge C. J. Gavin gave the talk on "Opportunities in the Electrical Field" at the weekly lunch on Jan. 26. He said that his real subject was "Electrical Men I Have Met," but he presumed the subjects were nearly synonymous, as he had met most of his electrical friends under "trying" circumstances. He traced the legal history of electricity in Colorado and especially spoke of the original "visionaries" who had done pioneer work. Mr. E. Edwards was elected chairman.

Electric Power for Canadian Farmers.—The Ontario Hydroelectric Commission will ask for an amendment to the provincial hydroelectric power act in order to bring about the supply of rural electrical service. The measure has not been yet introduced, but it is stated that under its provisions a minimum of twenty farmers can make requisition to obtain a local power service, the cost of distribution being chargeable against the users, the electric power to be supplied at reduced voltages to the distribution system erected and maintained by the farmers.

Minimum Lighting Rate in Ohio.—In a suit at Springfield, Ohio, last week, Judge Middleton handed down a decision denying the right of the Springfield Light, Heat & Power Company to make a minimum charge of $1 a month to consumers. Since the new ordinance fixing the rate at 8 cents per kw-hour went into effect the company has been enforcing this minimum charge, but the court holds that as the company accepted the ordinance fixing a maximum rate it has forfeited its right to fix a minimum charge which would make the rate of any consumer more than the maximum named in the ordinance.

Governor Wilson on the Engineer.—At the tenth annual banquet of the Alumni of Stevens Institute, held at the Hotel Astor, New York, on Feb. 8, Governor Wilson of New Jersey was one of the speakers, his topic being "The Necessary Thoroughness and Skill of the Engineer and His Right to a High Place in Public Esteem." He spoke of the impossibility of graft in the engineering profession, showing how poor materials and workmanship would soon show up in such a way as to cause the downfall of the dishonest engineer. He drew a comparison between authorship and engineering, showing that while the author can write a book in which only one chapter is worth while the engineer must make his work uniformly good.

College Electrical Show.—The third annual electrical show by the students in electrical engineering at the Michigan State College, at East Lansing, Mich., will be held the second week in March. This year, the State Legislature being in session, special invitations will be sent to the members. At the time people from all over the State will be visiting the college because of other meetings going on. The features of the electrical show are principally in relation to the application of electricity to domestic uses, including electric heating and electric cooking devices, with exhibits of electric washing machines and electric vacuum cleaners. Methods of electric wiring and electric lighting will be exhibited and a typical dining-room or bedroom properly lighted will be a feature.

Slight Damage from Electric Fires in New York City.—The annual report of the electrical department of the New York Board of Fire Underwriters shows that twenty-four fires of those investigated were attributable to electricity and caused a loss estimated at $27,530. Five fires were due to short-circuits; nine were due to grounding of conductors on gas pipes and other metal; two were due to sparks thrown from operating switches; three were attributable to overloaded circuits; one was due to defective joints; one to loose contact, and one was due to heat from an incandescent lamp igniting inflammable material. Of two causes which resulted in no damage, one was due to an explosion of an incandescent lamp in gasoline, and one was due to the ignition of a moving-picture film in a booth.

Brooklyn Edison Company to Entertain Contractors.—On Feb. 25 the Edison Electric Illuminating Company of Brooklyn will entertain the electrical contractors of the city at the Montauk Club. The Brooklyn Edison Company maintains most cordial relations with the electrical contractors and this is one of the get-together methods it frequently employs.

Meeting of the National District Heating Association.—The third annual convention of the National District Heating Association will be held in Pittsburgh on Tuesday, Wednesday and Thursday, June 6, 7 and 8. The headquarters will be in the Fort Pitt Hotel, and the sessions and exhibits will be held in the banquet-room on the ground floor of that building. The program will be of more than usual interest to those engaged in central-station heating. Eleven papers, covering a wide range of subjects, will be presented and discussed. All papers will be printed in advance of the convention. The entertainment provided will be especially interesting and the city selected is particularly advantageous both as to accessibility and interest for central-station heating men. Mr. D. L. Gaskill, Greenville, Ohio, is secretary.

Dam Blown Up to Get Light for City.—According to a dispatch from Pocatello, Idaho, by voluntarily sacrificing property valued at $100,000, former Governor Brady, on Feb. 4, furnished electric lights to Pocatello, which had been in darkness since the substation and transformer house of Brady's power company was destroyed by flood water two nights previously. "By dynamiting the power company's dam," says the dispatch, "Brady, who personally superintended the work of redeeming Pocatello from darkness, was able to reach the company's transformers, buried deep below the surface of a flood in the Portneuf River, and connect them again with the company's high-tension transmission line from the plant at Ann Falls. Three hundred pounds of dynamite were used in blowing out the company's dam to reduce the level of the flood water around the wrecked transformer house. By the lifting of the railroad blockade and the resumption of the electric light system Pocatello is once again in normal condition."

Proposed Pole-Line Legislation.—A bill has been introduced in the California Legislature proposing radical changes in the stringing of power, telephone and telegraph wires in that State. The bill requires a distance of 13 in. between the pole and a wire, making a space of 26 in. in which the lineman will be free to work. Cable lines are to be strung on crossbars, instead of along the poles on brackets, and laterals from underground conduits to the crossbars of poles must be incased in wooden casing of 1½ in. thickness. The big fight of the Electrical Workers' Union is for the 26-in. space between the wires on crossarms next to the pole. A representative of the Electrical Workers' Union of San Francisco during the hearing on the bill explained that a space of 26 in. for the lineman to work in at the crossbars of the poles was absolutely necessary for his safety, as in that space he could shift about and would not be obliged to crawl around and come in contact with the high tension of live wires on the pole. Yellow paint for the crossarms carrying high-power wires was also advocated to warn the lineman of the danger. Mr. John A. Britton, of the California Gas & Electric Corporation, asked that the law be made to apply to lines to be constructed hereafter, giving the companies four years at least to change the existing lines to conform to the new requirements. Mr. Britton explained that the Public Utilities Commission, which he stated he fully expected would be formed this year, will have entire charge of such matters.

STATION OF THE MIDDLETOWN (CONN.) ELECTRIC LIGHT COMPANY.

Complete Substitution of Alternating Current for Direct Current on All Circuits.

THE Middletown Electric Light Company was one of the earliest companies in Connecticut to undertake public electric lighting. Naturally, the apparatus first installed became antiquated and inadequate for the growing demands of the large business that developed under the management of Mr. L. C. Whitney, who has been manager of the company for the past seven years.

The original plant was located in the center of the city to permit the favorable distribution of direct current through a three-wire system. The generators were belted to a jack-shaft driven by simple, non-condensing engines, which were added from time to time as the demand for energy increased.

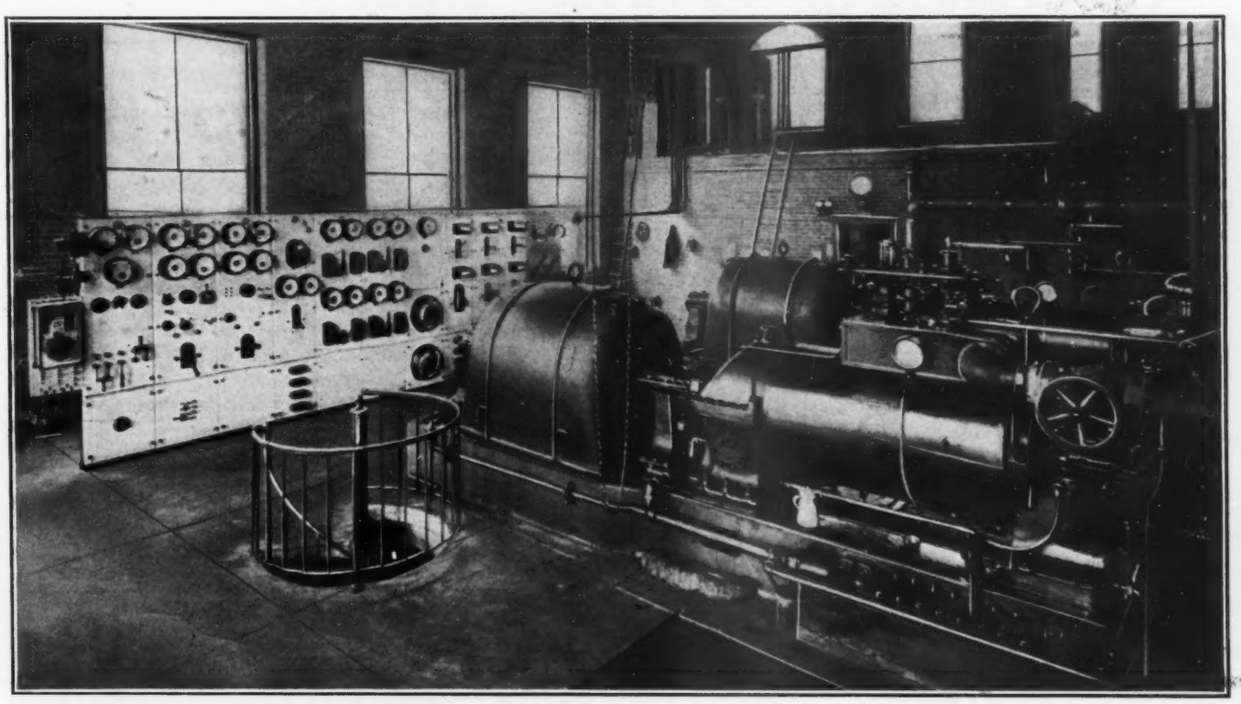


Fig. 1—General View of Generating-Room.

With the extension of the circuits to outlying districts and particularly for supplying energy to motors it became necessary to install an alternating-current system and two-phase belted generators, and additional engines were purchased until the number of machines in the plant required to carry the load during the winter of 1909-1910 had reached a total of thirteen, with the coal consumption averaging about 9 lb. per kw-hour.

Three years ago a hydroelectric company offered to deliver energy to the Middletown company at 1½ cents per kw-hour on a meter basis. This price compared with the cost of producing energy in the style of station then owned by the company seemed so attractive that a contract was signed, but the hydroelectric company failed to complete its plant, and last winter its successor made another proposition to the Middletown Electric Light Company to furnish alternating-current energy delivered to the high-tension side of transformers to be located on the property of the Middletown Electric Light Company at the price of 1¾ cents per kw-hour, with a load-factor of 26.7 per cent at the start, increasing to 35.7 per cent at the end of ten years, the life of the contract.

For advice as to the desirability of this proposition the Middletown company called in Mr. Henry Floy, consulting engineer, of New York City. Mr. Floy advised that when considered in connection with the transformer and switchboard losses, as well as the stand-by charges, the interest and depreciation on the investment required to put the station in the necessary condition to comply with the terms of the contract as to a reserve steam plant, the contract price named was higher than the cost of producing energy by a modern steam plant. The results of this analysis and conclusion indicate the necessity for careful consideration of the apparent saving to be effected by the use of water-power as against steam and explain why the auxiliary obligations assumed in purchasing water-power energy apparently furnished at less cost often result in a real increase in the expense of energy production. The Middletown company's directors thereupon decided to build a new station on the bank of the Connecticut River. Plans and specifications were immediately got out and contracts promptly let, so that construction work was begun May 5 and so expeditiously carried forward that the station commenced taking up its electric load exactly four months and one day thereafter and ever since has been successfully performing its functions.

In March wash borings had been made to determine the suitableness of the proposed building site and sandstone rock was located at a depth of from 20 ft. to 30 ft. The engineer's plans contemplated a building supported on concrete steel piles, and the contract for this work was awarded to the Raymond Concrete Pile Company, including that for the concrete floors and walls up to an elevation of 21 ft. This elevation was chosen because it was the highest point to which the river had been known to rise at any time during the last fifty years. The concrete piles, which were made monolithic with the building, averaged a little over 20 ft. in length. The upper part of the building is of Harvard brick, with black headers; the flat roof is of ferro-concrete carried on steel trusses and covered with tar and gravel, and a light limestone coping for the windows and trim gives an ornamental effect that harmonizes well with the concrete work. The contract for the superstructure was awarded to a local firm, Mylchreest Brothers.

All windows are considerably above the top of the concrete work, and four openings for doors have been provided with battens so that in case of an extreme rise in the river the doors may be closed and the operation of the station continued unin-

terruptedly. The building is strictly fireproof throughout, metal doors being provided to separate the boiler and engine-rooms, thus making it unnecessary for the company to carry any fire insurance whatever.

The company's old generating station, which has been abandoned, contained several 250-hp vertical "porcupine" boilers. Three of these which were in first-class order were removed and installed in the new plant and an additional new boiler was

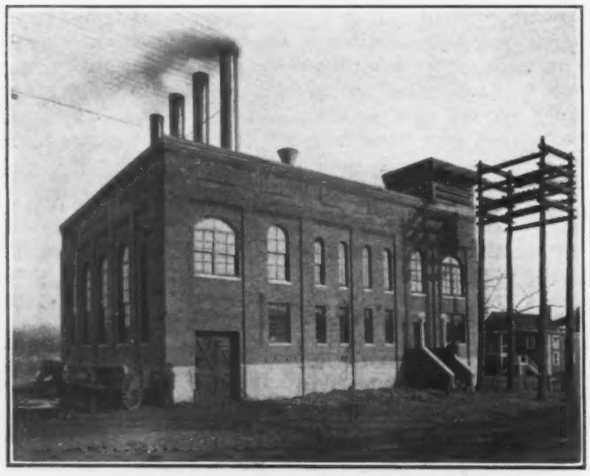


Fig. 2—Exterior View of Power Station.

purchased, making a total installation at present of four 250-hp boilers. Each of these is equipped with an independent iron stack 30 in. in diameter and approximately 30 ft. in height above the top of the boiler. The stacks pass through openings in the concrete roof, which are protected from the weather by means of iron umbrellas which encircle and are clamped to the stacks. The installation of automatic stokers was considered, but in view of the present operating capacity of the plant it was found that the advantages to be obtained would not compensate for the fixed charges and depreciation on the investment.

Although the property of the company is so located on the Connecticut River as to permit receiving coal in barges, the advantageous prices offered by local dealers caused the company to close contracts for local delivery of coal, thus saving losses in shrinkage, storage, investment, etc., necessary for apparatus to unload the fuel from barges. The company is prepared to install coal-handling apparatus in case any economies could thereby be effected. As spring floods are apt to inundate the property on which the plant is located and have been known to rise several feet over the adjoining streets, it was considered essential that a supply of coal be at all times assured. To meet this condition a contract was awarded to the Jeffrey Manufacturing Company for a 150-ton coal bunker with screw conveyor and elevator. Run-of-mine soft coal is dumped from 1-ton carts onto a steel "grizzly" at the corner of the building, which serves as the top of a concrete hopper. Pieces too large to pass through the 4-in. x 5-in. openings of the grid are broken by a mall, and the coal dropping onto the bottom of the concrete hopper passes through the building wall into a cast-iron boot located in a concrete pit below the boiler-room floor. The chutes for delivering coal from the bunker to the steel floor in front of each boiler, the boilers themselves and the feed-water piping are shown in Fig. 3. The piping was installed by Messrs Kellogg & Company in line with the best practice, the high-pressure steam piping being of wrought iron with Vanstone joints and extra-heavy cast-iron fittings with long-sweep bends. The downtakes from the boiler nozzles are of considerable length to compensate for the expansion in the boiler itself, this arrangement bringing the steam header relatively near the floor. The connections between the boilers and generating units are short and direct. Each boiler is equipped with Foster automatic non-return and stop valves. The main header may be cut in two by the closing of a heavy by-passed gate valve, leaving practically two headers, each connected to one-half the total boiler plant. There are an auxiliary header and two lines of piping supplying both exciters and both boiler-feed pumps; there are also twin boiler-feed lines, so that a shut-down of the plant is practically an impossibility.

The turbine-room is a large, well-lighted square room with brick partitions and gallery at one end and a basement for the condensing apparatus. The room is designed to accommodate two 500-kw and one 1000-kw steam turbo-generators, although at present only two 500-kw, 3600-r.p.m. Westinghouse-Parsons turbines driving Westinghouse two-phase, 60-cycle, 2400-volt generators have been installed, together with duplicate 25-kw turbines driving direct-current 125-volt exciters. The turbines are set on I-beams supported at either end and at the center on concrete piers, thus forming with the floor of the turbine-room the ceiling of the condenser-room and permitting the location of the condensers directly under and close to the exhaust outlet of the turbines. The condenser-room is waterproofed on the bottom and four sides and has no openings aside from pipes except through the turbine-room floor. In the condenser pit are two Leblanc condensers with steam turbines—that are operated condensing—driving rotary circulating and vacuum pumps. The exciter turbines as well as the boiler-feed and sump pumps exhaust into a 750-hp Cochran feed-water heater. In addition to the condensing apparatus there are located in the condenser pit sump pumps for discharging low-pressure drips into the sewer, a trap for returning the high-pressure drips to the feed-water heater and a galvanized-iron storage tank for receiving the discharge of the air pumps, which thus provide water for all power-house purposes except drinking. Water is taken by an automatically controlled pump in the boiler-room from the storage tank, passed through a Blackburn & Smith filter and discharged into a tank located about 20 ft. above the boiler-room floor. From this tank water is automatically supplied to the feed-water heater, which in turn supplies the boiler-feed pumps or furnishes hot water for the wash basins. In addition to the source of water supply from the river the city mains have been extended by the lighting company so as to make them available as a reserve and for supplying drinking water. A Westinghouse air compressor provides air for cleaning

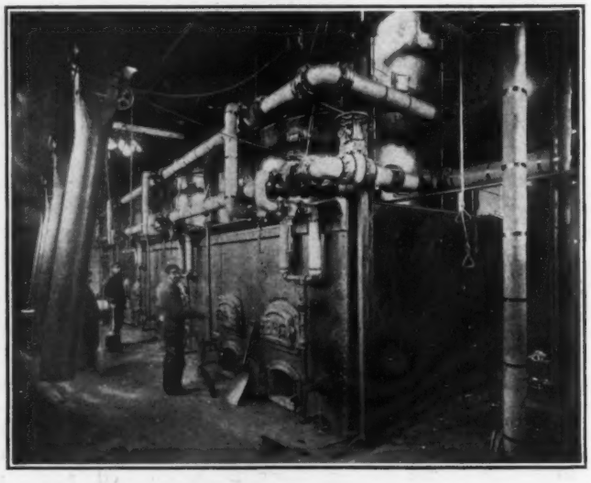


Fig. 3—Boiler-Room.

the electrical machinery, blowing out the boilers and operating the boiler-tube cleaners.

The switchboard consists of white marble panels with sub-bases, partly new and partly transferred from the old station. There are a single exciter panel to control the two exciter units, two generator panels with non-automatic oil switches, a totalizing panel with polyphase watt-hour meter, motor and lighting feeder-circuit panels equipped with Westinghouse fuses or

Condit time-relay switches and an alternating-current arc-lighting panel. A Tirrill regulator with a synchronizer and voltmeters adjoins the exciter panel. The panels are equipped with the usual instruments, such as indicating wattmeters, ammeters, etc. The arc transformers, which are located on the gallery over the offices, and the arc switchboard were transferred from the old station, set up and put in operation in one day, thus avoiding any inconvenience in the supply of street lighting in changing over from the old to the new station. The wiring in the building is all run in a loricated conduit embedded in the concrete floors or running up the brick walls to the wire tower in the southwest corner of the building, where the wires are fanned out on cross-arms preparatory to passing through porcelain bushings set in the wall of the tower to a wooden structure just outside of the building connecting with the pole lines. Each conductor has in circuit a choke coil located in the tower and a General Electric lightning arrester just outside the building on the wooden-pole structure. Incandescent lamps arranged in rows along the sides of the building are used for lighting, thus affording uniform illumination free from shadows.

The turbine-room is ventilated by means of 20-in. copper "Star" ventilators provided in the roof, which is also finished with copper flashings. Pure cool air is supplied to the turbines through galvanized-iron ducts leading from the south side of the building under the floor directly to the air intakes of the turbines. Heated air is discharged into the condenser room and, rising through gratings in the floor, passes off through the ventilators.

A concrete intake measuring 5 ft. square on the inside and 20 ft. in height was built on land and, the foundation having been prepared by a diver, was lowered into position flush with the dock line. On its front face are iron bars on 2½-in. centers and on the insides are twin net strainers with 1-in. openings. A 16-in. cast-iron intake pipe, protected by a ½-in.-mesh copper screen, conveys water from the intake to the condensers in the power plant. The circulating water, etc., is discharged through a 16-in. pipe running from the condenser-room to the corner of the plot upon which the plant is located.

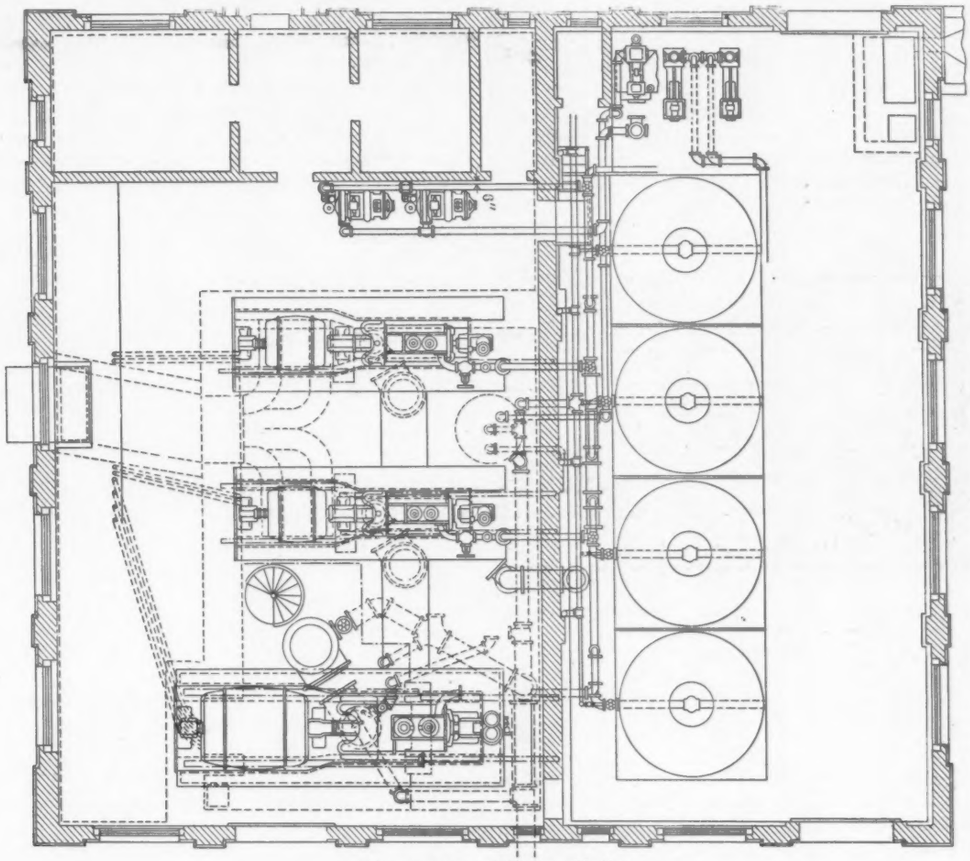


Fig. 4—Plan of Power Station.

When it was decided to build the new station it was also decided to abandon the use of direct current, which necessitated changing over more than 100 motors, in addition to fan motors, arc lamps, etc., of the direct-current type. The direct-current motors differed in size from a fraction of a horsepower up to 25 hp, and the change from direct current to alternating current required extensive changes in the distributing system. These have taken a long time to accomplish and have been relatively expensive. The changes have been made at such times and in such a way as to avoid inconvenience to customers.

The president of the Middletown Electric Light Company is Mr. D. Ward Northrop, the secretary and treasurer Mr. H. L. Mansfield, and the manager Mr. L. C. Whitney. Mr. H. A. Willard is chief engineer.

ADDITIONS TO COMMERCE STREET STATION, MILWAUKEE.

THE electrical generating capacity of the Commerce Street power plant of the Milwaukee Electric Light & Railway Company, Miwaukee, Wis., is being increased by two 14,000-kw high-pressure turbine alternators and two 7500-kw low-pressure turbine alternators, the latter utilizing the exhaust steam from the eight vertical, cross-compound engines already installed. The new work involves the installation of very extensive and complete switching apparatus for the alternating-current section of the plant, including a number of interesting features embodying the most modern design and practice.

DEVELOPMENT OF THE PLANT.

The construction of the original Commerce Street plant, with its engine-driven equipment, was commenced in 1902 at the time the steam turbine was first attracting the serious attention of engineers. The plant was, therefore, originally designed with the idea of being only temporary to tide the system over such a period as might be required to determine the suitability from various points of view of the steam turbine for large power-plant work. Later, as the plans progressed, it was decided to make this plant of a substantial character so that it might be permanent and be held as a reserve in case a large turbine plant was built which would supersede it for regular operation. Under these conditions four vertical, cross-compound Allis-Chalmers engines (28 in. and 60 in. x 48 in.) were installed, direct-connected to 1500-kw, 13,200-volt, 25-cycle General Electric generators. Each engine received steam from two Edge Moor boilers, having a combined heating surface of 13,000 sq. ft.

The plant was built on the unit plan so far as possible, each pair of boilers having a separate self-supporting steel stack, and each alternator a separate turbo-driven exciter. So far as the piping is concerned (although headers are arranged for interconnection) any unit may be operated independently of the other units.

In the early part of 1904 the requirements of the system had become such that additional power was necessary, the increased demand being chiefly for 600-volt direct current for the operation of cars in the congested section of the city. Although the dependability of the steam turbine had by this time been pretty well established, this was only in connection with alternating-current generators. As the Commerce Street station was a favorable point from which to distribute direct current, it was decided on this account to add four additional engine units (32 in. and 68 in. x 60 in.) of the same type as before, driving 2000-kw, 600-volt direct-current generators. Simultaneously with this extension there was an increased requirement for 60-cycle alternating current for lighting and motor purposes.

As space was available under the switchboard gallery two 1000-kw vertical Curtis turbines driving 60-cycle, 2300-volt General Electric generators were installed. In connection with this installation there were added eight additional Edge Moor boilers of approximately 7000 sq. ft. heating surface each. The same unit plan of arrangement was carried out in this extension as in the first. Although the units, so far as piping is concerned, in each half are interchangeable, there is no steam connection between the two sections, so that the bursting of a pipe or any similar accident cannot affect more than half of the plant. The coal-handling apparatus of this plant consists of man-trolleys and special dumping wagons and Jones underfeed stokers.

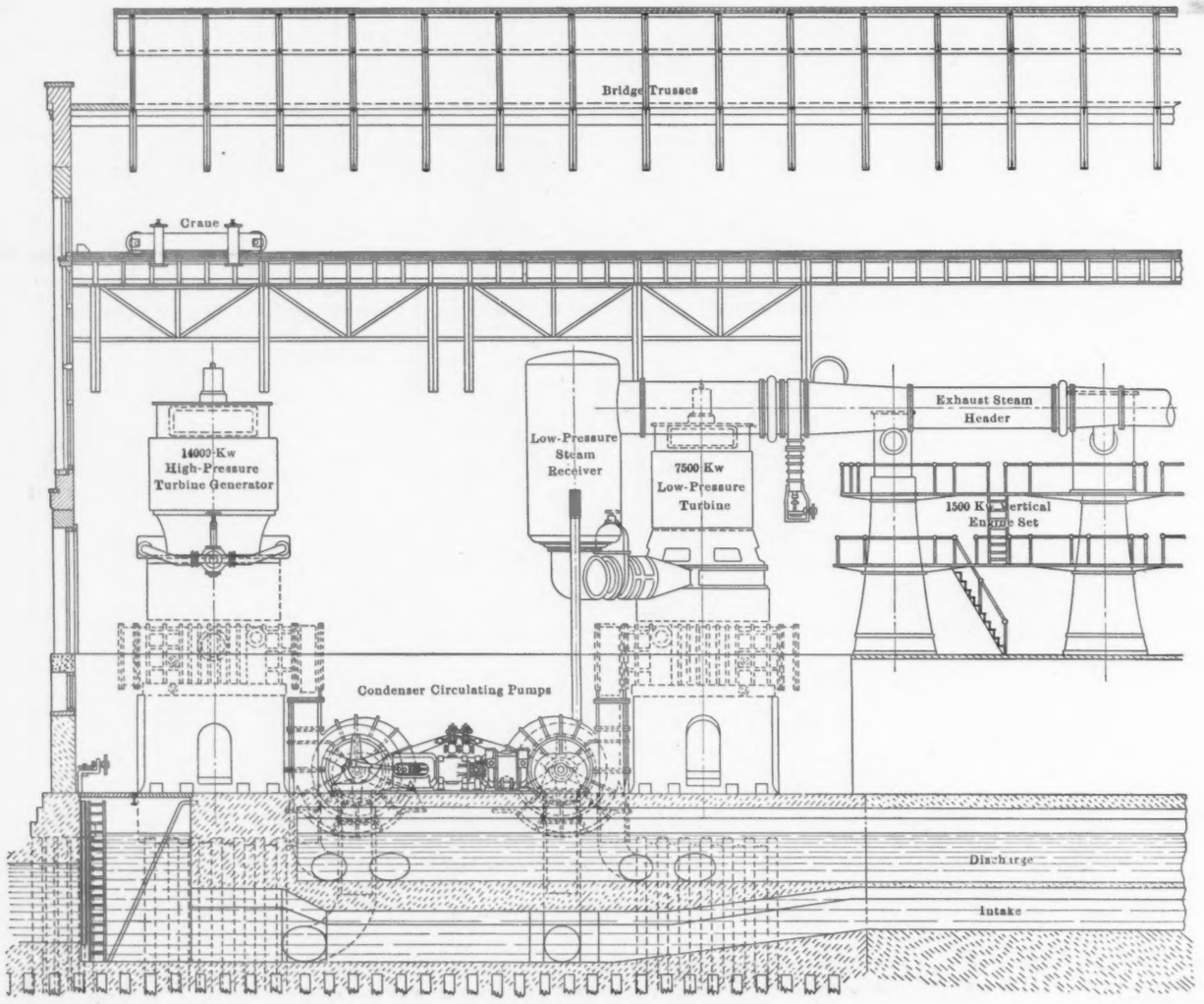


Fig. 1—Longitudinal Section Through Station.

PRESENT TURBINE ADDITION TO STATION.

Early in 1910 it was determined that further extensions and additions must be made, as the existing equipment was severely overloaded. Accordingly, an 80-ft. tract of ground north of the plant was acquired. Contracts have been placed for the building and machinery, and a large part of the building work

has now been completed. The machinery to be installed in this extension consists of two 7500-kw low-pressure, 25-cycle, vertical Curtis turbines and two 14,000-kw high-pressure, 60-cycle, vertical Curtis turbines. The condensing apparatus for these four turbines is exactly alike, both for the 7500-kw low-pressure machines and the 14,000-kw high-pressure machines, the actual amount of steam in each case being approximately the same.

These condensers will be of the Worthington base type, located wholly under the turbines, and each will have 25,000 sq. ft. of cooling surface in 1-in. tubing. The circulating pumps, having a capacity of 30,000 gal. per minute, will be of the 36-in. centrifugal type, each driven by a 22-in. x 24-in. Laidlaw-Dunn-Gordon Corliss engines. These engines will also drive the dry-vacuum pumps, 31 in. x 24 in., direct-connected behind the steam cylinders. The wet-vacuum pumps are 5-in., two-stage centrifugal pumps, and will be arranged to be driven by both induction motors and small steam turbines. It is the intention of the boiler capacity. Having determined that under peak conditions a boiler horse-power can be produced without difficulty on about 5 sq. ft. of heating surface without materially affecting the efficiency of the boilers, the company's engineers have concluded that it is better to do this during the peak, operating all the boilers, excepting those withheld for cleaning repairs or during the lighter load periods of the day, than to have a much larger boiler installation, as is commonly done, operating at a ratio of 10 sq. ft. during the peak and having a large number of boilers banked all the rest of the day.

Each boiler is equipped with a superheater built on the top of the boiler and in reality an integral part of the boiler. This superheater has 25 per cent of the total boiler heating surface and is used as an economizer through which the gases pass after leaving the water-heating surface of the boiler. At normal rates of operation approximately 60 deg. of superheat is obtained from this source. In addition to this the eight new boilers which are to be installed and from which the high-

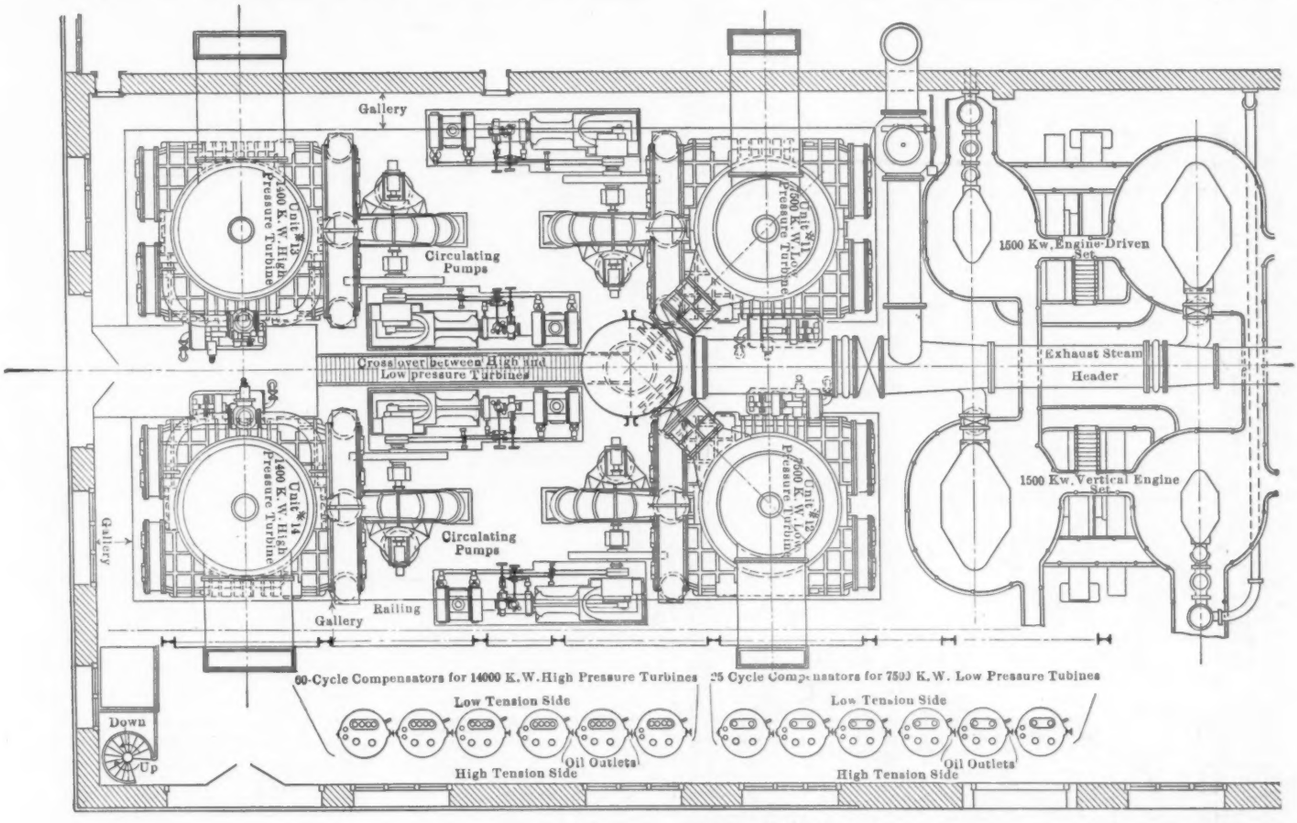


Fig. 2—Plan of Turbine Extensions.

normally to adjust the turbine speed of this unit so that the induction motor will be as nearly as possible in synchronism with the main generators, allowing the motor to float on the line. Should the turbine for any reason fail the motor would then continue to operate the pump, or if through any failure of the turbine governor the speed should materially exceed normal the motor would act as an asynchronous generator and tend to prevent disastrous overspeeding. Independent turbine-driven exciters will be provided, each directly connected to its respective generator.

BOILERS AND PIPING.

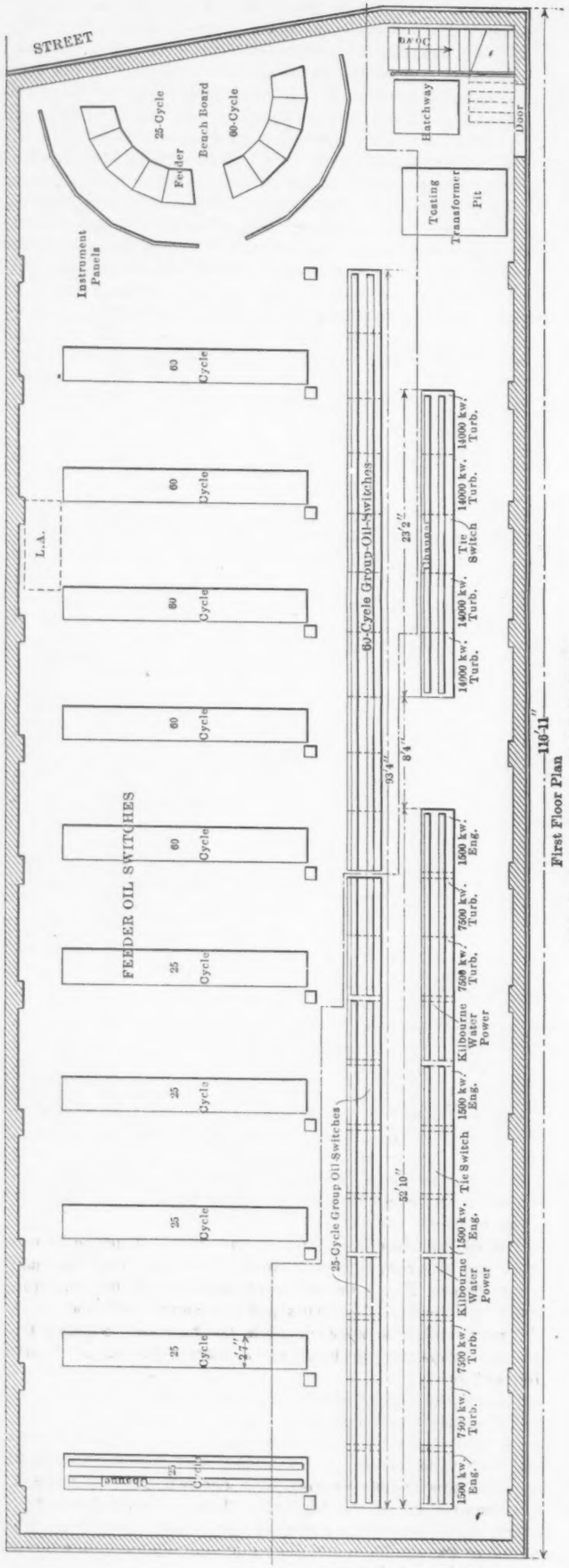
The boiler installation for this extension will consist of eight additional boilers similar to the original installation and each having 7500 sq. ft. of heating surface. For boiler feeding an arrangement of pumps with opposed cylinders is planned, using pot-form pumps with compound Corliss engines, in connection with Hoppes heaters.

It will be noted that, considered on a conventional basis, the total capacity in kilowatts in this plant is very much in excess

pressure turbines will be supplied will be equiped with Foster superheaters which will deliver the steam to the turbines at 150 deg. above the temperature of saturation.

It has been found by test that the various engines, non-condensing, will have their maximum efficiency with a total capacity of about 4000 kw in excess of the rating of the generator, and as the generators will readily operate without excessive heating with this additional load the total station capacity is considered to be 63,000 kw. The real estate occupied by this installation is 143 ft. x 240 ft. So far as the power plant proper is concerned there is, therefore, 1 kw installed for each 0.545 sq. ft. of real estate.

A feature of this installation which, in its construction, has involved much study is the low-pressure piping between the engines and the turbines into which they exhaust. To make this piping as short as possible and to avoid unnecessary bends it was decided to carry it overhead, and the last end of this pipe, next to the separator, was made 66 in. in diameter in order to reduce the velocity of the steam sufficiently to permit proper



First Floor Plan

Fig. 3—Arrangement of Oil Switches.

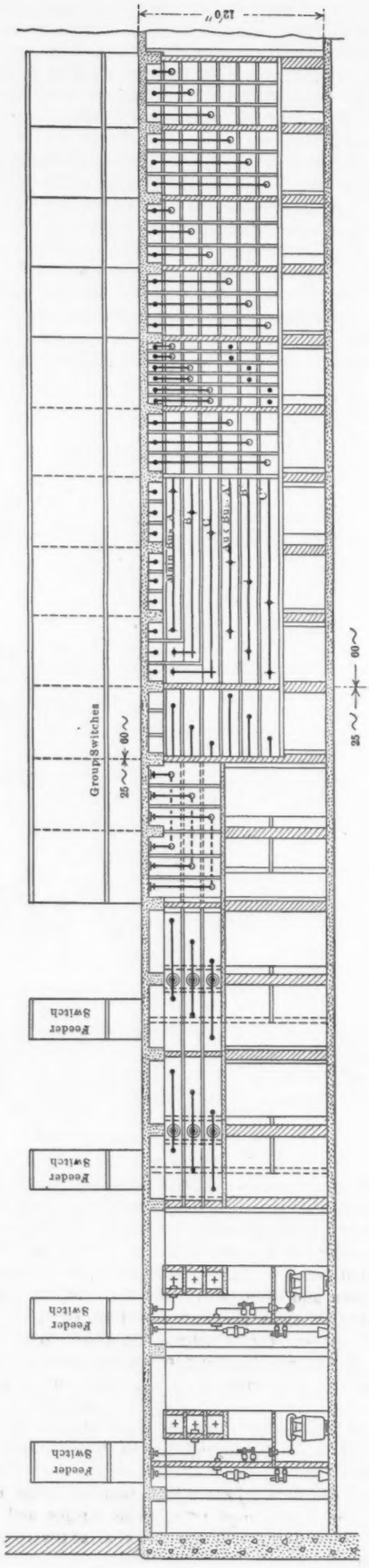


Fig. 4—Section Through Switch House, Showing Bus Structure in Basement.

action on the part of the Hoppes separator. This separator is 10 ft. in diameter and approximately 22 ft. long. As the pipe referred to has a fairly rigid connection to each engine, the expansion must be necessarily taken up at intervals between the engines. However, as it was not considered safe to trust to the rigid connections as anchorages it became necessary to design a harness which would anchor the pipe to itself.

GENERATING EQUIPMENT.

As has already been mentioned, the new generating equipment of the enlarged station will comprise two 14,000-kw, 60-cycle turbine generators and two 7500-kw, 25-cycle low-pressure-turbine machines. This apparatus will be in addition to the existing equipment of four engine-driven 1500-kw, 25-cycle, 13,200-volt alternators, four engine-driven 2000-kw, 600-volt direct-current generators, and two 1000-kw, 4000-volt, 60-cycle turbine generators, whose output is used directly for lighting purposes.

The 60-cycle, 13,200-volt feeders will thus be supplied from two 14,000-kw alternators, while the 25-cycle generating equipment of the station will comprise the four existing 1500-kw, engine-driven, 13,200-volt, 25-cycle alternators, together with the two newly installed low-pressure turbines driving 7500-kw, 25-cycle alternators and utilizing the exhaust steam from the eight engines.

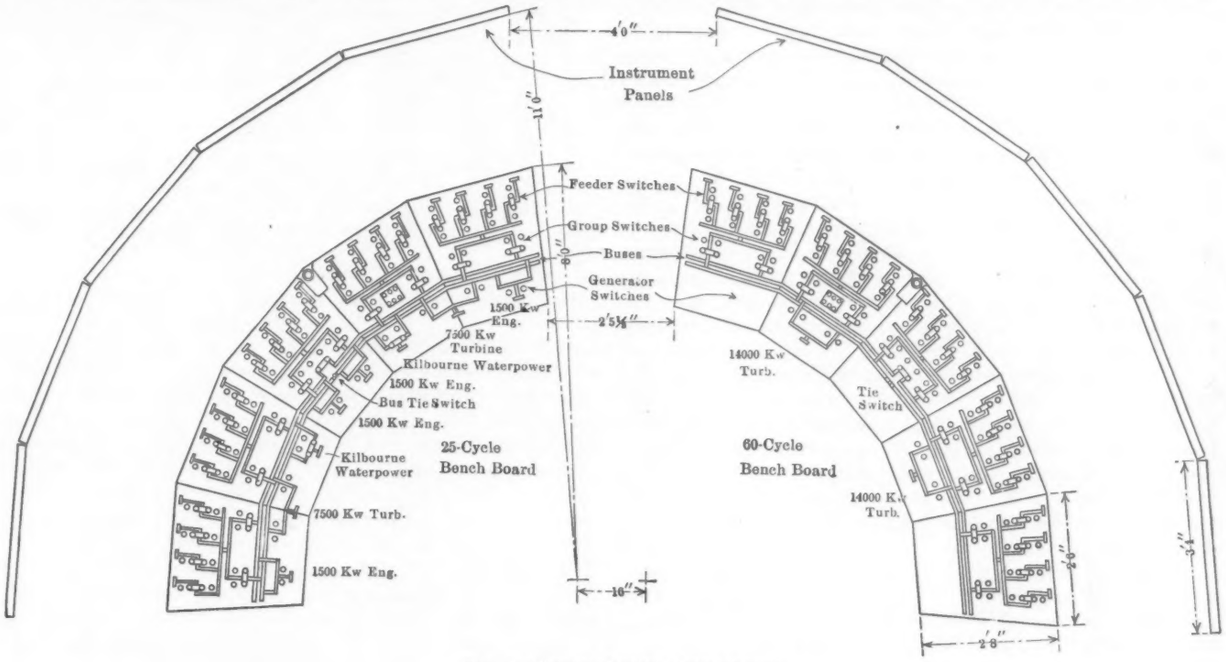


Fig. 5—Feeder-Control Benchboard.

GENERATOR COMPENSATORS.

The generator pressure of both the new 14,000-kw and 7500-kw turbine generators is 6600 volts, or one-half the bus potential of 13,200 volts. The energy from the generators will be fed through compensators of the auto-transformer type having a ratio of one to two between taps. These compensators will be installed under the operating switchboard gallery in the generator room and directly opposite the machines they serve. The 7500-kw, 25-cycle generators will be equipped with banks of three 1250-kw compensators, the total three-phase rating of these groups aggregating 3750 kw, or one-half of the generator rating, since only half of the generator output is actually transformed in the compensators. The 14,000-kw, 60-cycle generators will be similarly served by banks of three 2333-kw compensators aggregating 7000 kw in three-phase rating. The use of these compensators with half-potential generators marks the newest practice in the installation of large turbo-generator units and is designed to suppress surges and to protect the armature coils of the generators against severe shocks or short-circuits.

The incoming 25-cycle transmission lines from the 8000-hp Kilbourn water-power plant on the Wisconsin River, 120 miles distant, pass through the Commerce Street station from the West Allis substation and are handled as local station generating capacity in making up the busbar connections at the operating switchboard, being furnished with oil-switch remote control similar to the other generator units. In the case of these transmission-line switches this control is duplicated at the feeder switchboard in the switch house.

The generator switchboard will be equipped with operating signals of the ship's type, duplicate dials with pointers indicating positions labeled "Stop," "Start," "Field Off," etc., being installed on the gallery and at the side of the turbine units themselves, so that close communication can be maintained with the generator floor. The generators will also be equipped with totalizing watt-hour meters, while indicating wattmeters showing the load on each machine are to be installed near the steam gages for the engineer's reference.

SWITCH HOUSE.

The electrical switching of the enlarged and reconstructed Commerce Street station will be divided between the overhead "operating" switchboard in the generator room itself and the dispatching or feeder benchboard in a new switch house erected just across Poplar Street from the power house. All operations pertaining to the actual manipulation of the machines themselves, including the connection of incoming generators to the busbars, will be controlled from the generator switchboard, while the switching of the ten group and forty feeder circuits will be handled from the feeder benchboard at one end of the special structure in which the group and feeder oil switches are to be housed.

The switch house is a 117-ft. x 40-ft. brick structure of one story and basement, and is about 60 ft. distant from the main power house. Fig. 4 shows the arrangement of the generator, group and feeder oil switches and the control switchboard on the main switch floor level, while the basement contains the busbar compartments, lightning arresters, instrument transformers, etc.

The control benchboard in the switch house, locally designated as the "feeder benchboard," will comprise two five-panel sections, ranged on the arc of a circle. The left-hand section will control the twenty 25-cycle feeders and the right-hand section the same number of 60-cycle feeder switches. On the vertical boards behind the benches will be mounted the instruments, etc. The arrangement of the switch contacts on the panels of the benchboard follows that of the oil switches themselves in the switch house.

The duplicate 60-cycle and 25-cycle generator buses are sec-

tionalized at points of symmetry of connected apparatus, the main buses being broken by remote-controlled tie switches, while the auxiliary buses are equipped with simple disconnecting blades only. The tie switches will be operable from both the feeder benchboard and the operating switchboard in the power house, indicating lamps at both points showing the position of the switches. Each half of the 25-cycle buses will be arranged to be connected to two 1500-kw engine-driven alternators, two 7500-kw turbine generators and one Kilbourn line, the corresponding switches being grouped symmetrically about the sectionalizing switches. These generator switches will be controlled entirely from the generator switchboard in the power house, indicator lamps showing the position of the switches at the feeder board. The Kilbourn or West Allis substation lines, however, will also have control points located on the feeder benchboard so that they can be handled from either board.

The group switches, each controlling four feeder circuits, will be ranged in a row parallel with the generator switches and, like the four feeder switches under each of them, will be all controlled from the feeder switchboard. The feeder switches will be installed in parallel rows at right angles to the generator and group switches and directly over the group buses, at the end of each of which aluminum-cell lightning arresters will be connected. Ample room has been left in the busbar compartments so that instrument transformers can be connected on any feeder to register the energy taken by it. At the control benchboard name-plates will be attached to the group-switch contacts, showing the destination of the feeders connected under each group. The oil switches in the switch house will be inclosed in clear wire-glass doors, so that an unobstructed view of the operating parts and, indeed, through successive rows of switch inclosures will be rendered easily possible.

OTHER PLANTS OF MILWAUKEE SYSTEM.

The new reconstructed Commerce Street plant of the Milwaukee Electric Railway & Light Company will serve the combined electric railway and central-station load of the city in conjunction with the other steam plants of the company at Oneida Street and in the Public Service Building. The Oneida station contains two 1050-kw, 600-volt, engine-driven direct-current generators; one 1050-kw, 250-volt generator, and four 400-kw, 125-volt generators, besides two 1500-kw, 25-cycle, 250-volt motor-generator sets, one 500-kw balancer set and a 1500-amp-hour, 250-volt storage battery. In the Public Service Building, which contains the company's offices, are three 1500-kw, 2300-4000-volt, 60-cycle, non-condensing high-pressure steam turbines, exhausting into the steam-heating system from which the central section of the city is supplied with heat, and two 1500-kw motor-generator sets similar to those at the Oneida station. The Milwaukee system also receives about 6000 kw from the Kilbourn water-power plant, at the Dells of the Wisconsin River, 120 miles west of Milwaukee. This development, which was described in the *Electrical World*, Sept. 23, 1909, contains four 1500-kw, 2300-volt, 25-cycle, three-phase alternators, driven at 100 r.p.m. by 2778-hp, six-runner, 57-in. water turbines operating under 17-ft. head. Banks of single-phase, 1000-kw water-cooled transformers raise the generator voltage to the transmission potential, 44,000 volts, later raised to 70,000 volts. The concrete dam is 400 ft. long, rises to a maximum height of 55 ft. above the bed of the stream and is carried on a base 48 ft. wide. The superstructure is built as a spillway with twelve adjustable-crest gates. The Milwaukee company has also recently completed the construction of its Clinton Street substation on the south side of Milwaukee, which will contain four 2000-kw, 25-cycle, 600-kw rotary converters, three of which are being installed at once. This station has also been designed for use as a switching point for lighting service.

Mr. John I. Beggs is president and general manager of the Milwaukee Electric Railway & Light Company; Mr. C. J. Davidson is chief engineer of power plants, and Mr. O. M. Rau is electrical engineer.

EFFECT OF FREQUENCY ON THE VARIATION OF CANDLE-POWER OF INCANDESCENT LAMPS.

IN view of the discussion on the performance characteristic of incandescent electric lamps that followed the publication in our issue for Nov. 17, 1910, of the results of tests made by Prof. Charles L. Kinsloe at the Pennsylvania State College, it is believed that an account of tests made by Messrs. E. B. Kiely and H. P. Wasserboehr, Jr., at the Massachusetts Institute of Technology and submitted by them as a graduation thesis in June, 1910, will prove interesting at this time.

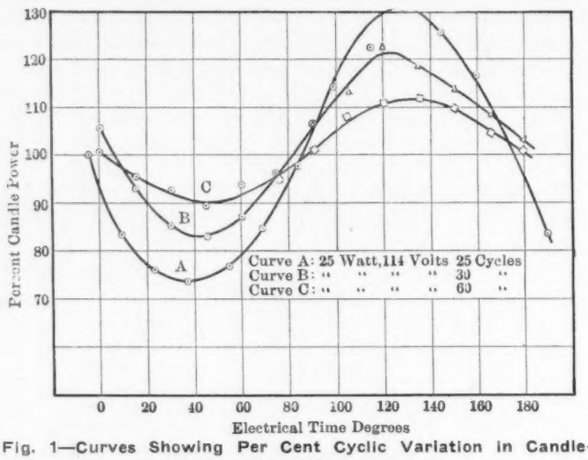


Fig. 1—Curves Showing Per Cent Cyclic Variation in Candle-Power Tungsten-Filament Lamps.

The tests have a bearing on the present discussions, in showing the initial variation of candle-power fluctuation with frequency for sinusoidal e.m.f. waves, but they are not directly comparable with the results reported by Professor Kinsloe, whose tests related to the effect upon the life and mean candle-power throughout life of the variation in the wave-form of the e.m.f. at constant fundamental frequency. However, they do indicate the extent of candle-power variation which may reasonably be expected in well-designed systems.

The method of determining the candle-power variations, briefly stated, consisted in measuring the intensity in a single horizontal direction at successive and regular electrical time intervals throughout the cycle. A small single-phase synchronous motor, which had been developed and built in the laboratories of the Institute, was arranged to rotate a sectored disk in front of the lamp. This occluding disk had six slots, one per pole of the driving motor, and each with an opening of 8 mechanical degrees. It was adjustable about the motor shaft to provide for admitting light to a Lummer-Brodhun photometer at any desired point in the cycle. The field of light was

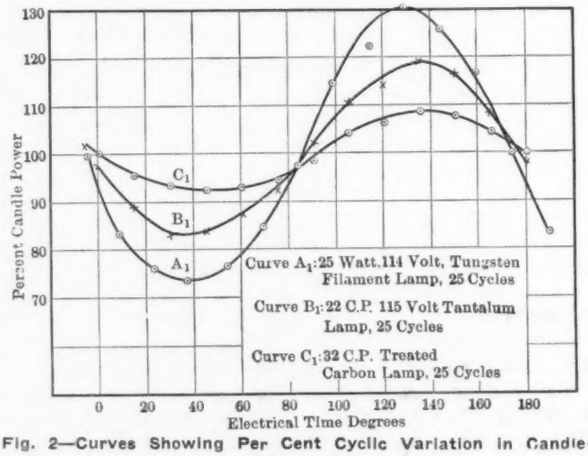


Fig. 2—Curves Showing Per Cent Cyclic Variation in Candle-Power.

reduced by a second fixed screen having a ¼-in. slot. In order to obtain the maximum and minimum points of the candle-power curve the fixed and revolving slot widths had to be very small, while to reduce the error due to passage of slot through the field required a large ratio of revolving to fixed slot width. After some experimenting the above-mentioned widths were adopted as the best compromise and no correction was made in the final results.

Owing to a difference in ratio of energy input and output at any instant, a lag is introduced into the candle-power curve.

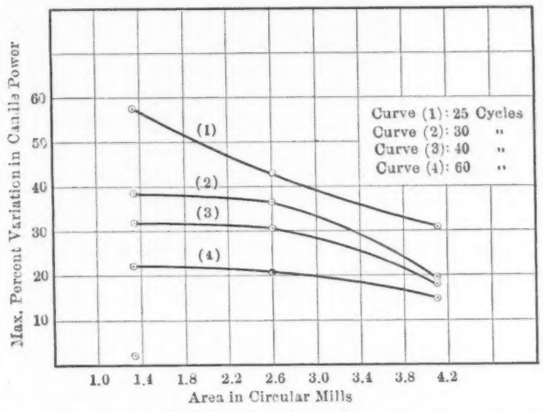


Fig. 3—Maximum Per Cent Candle-Power Variation and Cross-Sectional Area of Tungsten Filaments.

In order to investigate this matter, and also to determine the zero current point and to provide a means of detecting any angular oscillations in the synchronous motor, an ingenious application of an oscillograph was made. The vibrator was connected in the lamp circuit and a direct-current carbon arc lamp was placed before the revolving disk. The intense beam of light from the arc was reflected by means of a train of mirrors and totally reflecting prisms to the vibrator mirror and thence to the ground-glass screen. With the cylindrical

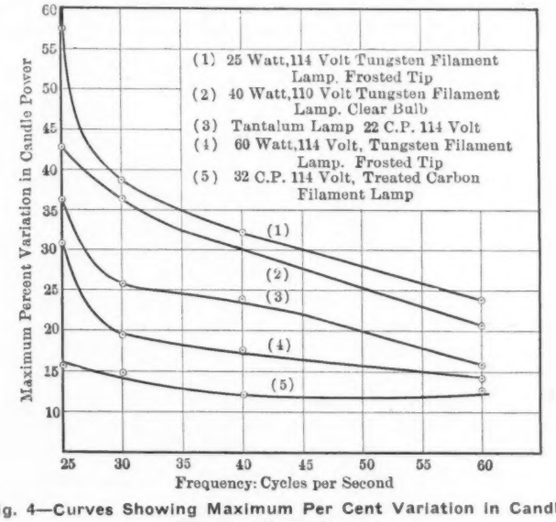


Fig. 4—Curves Showing Maximum Per Cent Variation in Candle-Power with Frequency.

mirrors at rest and observing the two images on the screen—because of two slots per pair of poles—the angular position of the occluding disk was easily adjusted for the zero current point. Any hunting of the motor was detected by surging of the images.

By these means candle-power curves were obtained for the following types of lamps: 25-watt tungsten, 40-watt tungsten, 60-watt tungsten, 22-cp tantalum and 32-cp treated carbon. The tests were made at 25, 30, 40 and 60 cycles—the variable frequency being obtained by means of a motor-generator set. The curves were obtained for rated volts, 5 volts above and 5 volts below, but the per cent variation was approximately the same, with exception of the 25-watt tungsten on 25 cycles, and will, therefore, be omitted from the summary of results.

All of the curves obtained of the candle-power show a form approximate to that of a sine displaced by the average value of intensity from the axis of abscissas.

The amplitude of variations increases very rapidly on the lower frequencies for the metallic-filament lamps. Fig. 1 shows the curves for the 25-watt tungsten-filament lamp on 25, 30 and 60 cycles. The ordinates are in per cent of the average candle-power obtained by the planimeter. All of the curves show a well-defined lag which is approximately 40 electrical time degrees, as will be seen by reference to the above-mentioned curves.

The amount of variation at a given frequency is largely dependent on the cross-sectional area, character of the surface, and heat storage capacity of the filaments. The curves of Fig. 2 are given to show the differences in amplitude for the 25-watt tungsten, 22-cp tantalum and 32-cp carbon, all on 25 cycles. It may also be interesting to note the relation between variation of intensity and area of cross-section for the tungsten-filament lamps, which is given in Fig. 3.

The results of the thesis which are most useful are put in the form of summary curves shown in Fig. 4, where the percentage variation is considered as 100 times the difference between the maximum and minimum divided by the mean. It is to be noted that the metallic-filament lamps show a point of sharp curvature between 25 and 30 cycles. In a paper before the A. I. E. E. Dr. Clayton Sharp reported stroboscopic tests on an 8-cp carbon lamp, and at the time called attention to a possible critical frequency between these limits. This fact points to the desirability of adopting a frequency for low-frequency incandescent lighting slightly above the point of curvature.

While the methods involved in a work of this kind offer many chances for experimental error, the general consistency of the results and the extreme care with which they were taken lead the writer to offer them as reliable information on the subject in question.

RELATIVE EFFICIENCY OF LIGHT PRODUCTION BY CONSTANT TEMPERATURE AND VARIABLE TEMPERATURE INCANDESCENT LAMP FILAMENTS.

By Evan J. Edwards.

THE question of relative efficiencies of incandescent lamps operated on direct current and on alternating current has been much discussed, but never very carefully analyzed. The writer has not found that the question of the existence of a difference in efficiency is a settled one. Therefore, of course, no quantitative values have been presented. It is the purpose of this discussion, mainly, to present a method by which the efficiency ratio may be quantitatively obtained for any candle-power function on the basis of equal light production and to show that the efficiency of a given average of light production is probably always higher when obtained from a varying filament temperature.

It may be well to begin a discussion of this kind by a few general considerations of the problem in hand and to define some of the terms which will be used. A lamp filament is a receiver of energy, a holder of energy and a deliverer of energy when in operation. When operated at constant temperature it receives energy at a certain rate, depending on the pressure applied and the resistance of the filament; it holds a certain amount of energy, depending on the temperature, dimensions and specific heat; it delivers energy by radiation and conduction (mostly radiation) at a rate determined by the temperature and exactly equal to the rate of receiving. But when operated at variable temperature, as by alternating current, it receives energy at a certain rate at any instant of time depending on the

pressure applied and the resistance of the filament at that instant of time; it holds a certain amount of energy which depends on the difference between the total input and output of energy up to that time; it delivers energy at a rate which depends upon the temperature at that instant and upon nothing else for a given lamp. Moreover, it delivers exactly as much during one cycle as it receives during that time. Therefore, there are three energy relations which need to be considered in connection with this problem; namely, the rate of energy input, which will be referred to as the input; the actual energy stored in the filament, and the rate of energy output, which will be referred to as the output.

Obviously, in the case of a filament operating at a variable temperature the input, the filament energy and the output are all variable. The filament temperature rises during the time over which the input exceeds the output. The important fact in this connection, however, is the dependence of the output upon the filament temperature and therefore upon the luminous intensity. This function (variation of output with candle-power) can be very easily obtained experimentally, since under constant condition of filament temperature the output is equal to the input. It is, therefore, necessary only to operate the lamp

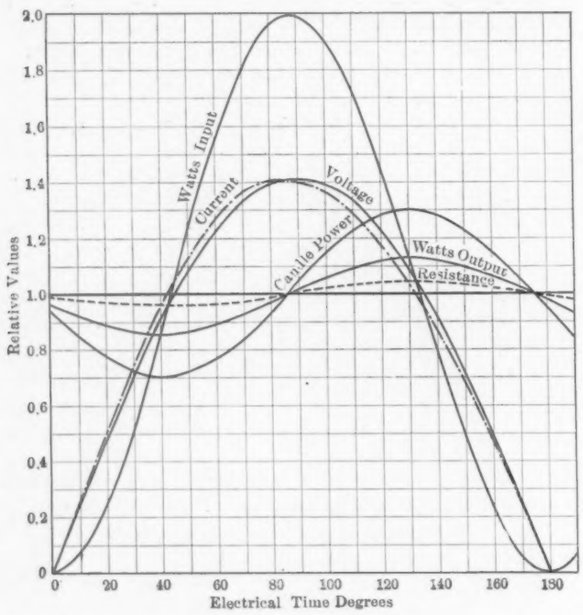


Fig. 1—Curves Showing Instantaneous Performance of Tungsten-Filament Lamps on Alternating Current.

at various luminous intensities and measure the power input. This relation for all types of incandescent lamps is very approximately of the form

$$\text{Watts} = K\ (\text{cp})^n \qquad (1)$$

where "n" is a constant for any particular type of lamp and varies from about 0.432 for tungsten to about 0.336 for untreated carbon. The exact relation may be expressed in the same form except that "n" is a variable and a function of the candle-power.

Perhaps the above analysis will be more easily understood by referring to Fig. 1, which is a picture of all the variations going on within a lamp. It is drawn for a 30 per cent sine variation of candle-power, above and below the average, for tungsten filament. The output and resistance functions are built up directly from the candle-power. The voltage is taken as a sine, the current from the voltage and resistance and the input from the voltage and current. The scale is unity for average values in all cases except current and voltage, which are taken as unity for the effective voltage value. The lag of candle-power behind input watts is easily located since, at the instant of either maximum or minimum output and candle-power, the output and input must be equal. This is, of course, true because the temperature is constant at these points. In mathematical terms the angle between crest of voltage and crest of candle power is

$$\Theta = \cos^{-1} \frac{(\text{cp max.})^{\frac{m+n}{2}}}{\sqrt{2}}$$

where "n" is defined by the relation of watts output to candle-power in the equation

$$W = (\text{cp max})^n$$

and "m" is defined similarly for resistance and candle-power in equation

$$R = (\text{cp max})^m$$

Maximum candle-power is, of course, expressed as the ratio to average. Θ is given in degrees for various lamps at several values of maximum candle-power in the following table:

Maximum Candle-Power.	Tungsten.	Tantalum.	Graphitized Carbon.	Carbon
1.4	39.2°	39.8°	40.7°	41.7°
1.3	40.5°	41.1°	41.7°	42.2°
1.2	42.0°	42.4°	42.7°	43.0°
1.1	43.5°	43.7°	43.8°	44.0°

Although the angle of lag has no particular bearing upon the subject of this paper, it might be excusable to comment at this point upon its very narrow possible limits. As will be referred to later in this paper, the 30 per cent rise in candle-power for tungsten filament represents the maximum found in practice. The angle is probably always between the limits of 40 deg. and 45 deg. for a sine voltage.

In order to compare the efficiency of light production under conditions of variable temperature with that obtained under conditions of constant temperature let it be assumed that the same average luminous intensity (taken as unity for simplicity) is to be obtained with the same lamp in each of the two ways. Let the power required (output or input) in the case of constant temperature be unity. Then power output at any instant for variable conditions is

$$w = (\text{cp})^n \qquad (2)$$

Total energy output or input per candle-power cycle is

$$E = \int_0^{2\pi} (\text{cp})^n\, d\,\Theta \qquad (3)$$

And the ratio of energies (variable to constant) is

$$\text{Ratio} = \frac{1}{2\pi} \int_0^{2\pi} (\text{cp})^n\, d\,\Theta \qquad (4)$$

Therefore, the relative efficiency may be obtained for any case where the candle-power function and "n" are known.

Let a simple case be taken as an illustration. The candle-power of a 25-watt (110-volt) tungsten-filament lamp operating at 25 cycles varies about 30 per cent above and 30 per cent below the average value and is of a form more or less approximate to a sine. The exponent "n" has an average value of about 0.432. Then if it be assumed that the exponent remains constant for the range taken, the ratio of energies (alternating current to direct current) required to produce the same average candle-power is given by

$$\text{Ratio} = \frac{1}{2\pi} \int_0^{2\pi} (1 + 0.3 \sin\ \Theta)^{0.432}\, d\,\Theta = 0.9943$$

(mathematical integration).

In order to obtain the exact ratio of energies it is only necessary to take into account the difference brought about by the actual function not being a true sine and the fact that the exponent does not remain strictly constant. It is possible to obtain the candle-power function experimentally to a fairly good degree of precision. Several assumed functions covering

a range of deviation from the sine greater than could actually be realized in practice were taken, and the cases which were considered extreme introduced an error of less than 0.1 per cent in the energy ratio. The writer believes that the deviation of the candle-power from the sine will in any actual case introduce an error in the efficiency ratio of less than 0.03 per cent. The law of change of the exponent "*n*" may be determined experimentally for any lamp to a good degree of precision.

It is known that "*n*" increases with candle-power. The increase of "*n*" from 0.7 to 1.3 of normal candle-power as obtained by experiment on various lamps is about 1.6 per cent for tungsten, 2.6 per cent for tantalum and graphitized carbon and 2.8 per cent for treated carbon. (Change expressed in per cent of normal "*n*".) Approximately 4 per cent change is required to change the energy ratio by 0.1 per cent and an 18 per cent change is necessary in order that the energy ratio be unity. (Obtained graphically.)

The above considerations apply to all conditions of operation of incandescent lamps operated on alternating current. The larger lamps and higher frequencies change only the amplitude of the candle-power function and the ratio of energies becomes closer to unity. It seems very safe to conclude that for any case the efficiency ratio may be obtained to a precision of better than 0.1 per cent by obtaining the amplitude of candle-power and values of "*n*" experimentally and assuming the candle-power variation to be a sine. Moreover, in view of the fact that "*n*" changes by much less than the value required to make the ratio unity for all commercial incandescent lamps, it seems also justifiable to conclude that a given average candle-power is always obtained more efficiently by alternating-current than by direct-current operation.

The energy ratio has been worked out for all types of lamps, assuming the candle-power function to be of the form of a sine and using the actual function connecting watts and candle-power as determined experimentally, and it is submitted in Fig. 2. As will be seen, the ratio is plotted with variation of the amplitude of the candle-power in order that it may be applied to various sizes of lamps and frequencies of operation. Making

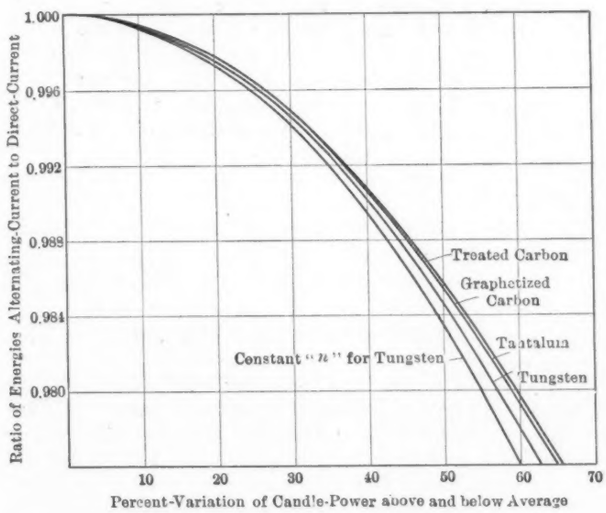


Fig. 2—Relation Between Energy Ratio and Candle-Power Variation.

use of the data obtained by Messrs. Kiely and Wasserboehr* at the Massachusetts Institute of Technology, the energy ratio of the various sizes and frequencies is plotted in Fig. 3 and gives the energy ratio within the precision of their work. It is included here as an illustration of the application of the above method of analysis to some practical cases and also to put into convenient form the values of efficiency ratio which may be expected from these lamps under various conditions of frequency.

*See page 430 of this issue.

It was the intention in the beginning to present a method rather than to give accurate quantitative results in this paper. The actual values as given by the curves may be slightly modified by later and more exhaustive work in connection with obtaining the law of change of watts with candle-power or by changes in the characteristics of the filaments in question due to new and improved methods of manufacture. However, these results will be affected little, as will be seen by reference to

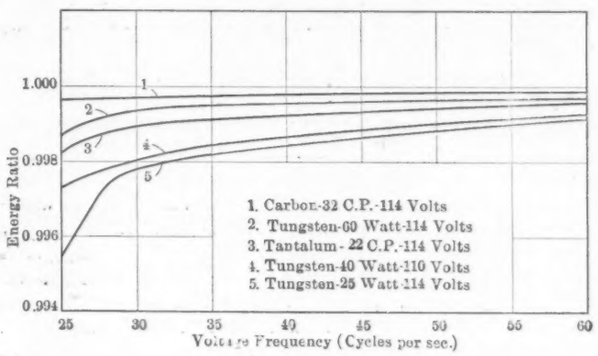


Fig. 3—Relation Between Energy Ratio and Voltage Frequency.

Fig. 2, by noticing the effect of the change of exponent for tungsten, one curve being plotted for constant "*n*" and the other for a variation of 1.6 per cent between the limits 0.7 and 1.3 normal candle-power.

The ratio of energies as given above, of course, is directly the ratio of the specific consumption when expressed in watts per candle-power. It should be noted that it is the relative efficiency when operated at the same average candle-power, and not the ratio of candle-powers at the same effective voltage. The ratio of intensities at the same effective voltage is probably a little closer to unity than the energy ratios for the same candle-power, since a lamp operates with a power-factor slightly less than unity, the current slightly leading the voltage, except at the zero voltage points for filaments with positive temperature-resistant coefficient. Careful photometric tests have indicated a higher average candle-power when operated at variable voltage, but such tests can hardly be expected to afford a means of accurate determination, since the increase in candle-power is probably no greater than 0.2 to 0.4 per cent in extreme cases, while an average deviation from the mean of candle-power settings of not over 0.4 per cent is considered very good in photometric work.

The results as given in the above curves would be very difficult to obtain by actual measurement on a photometer, because in addition to the lack of photometric precision one would encounter difficulty in measuring the alternating-current power input to a sufficient degree of precision.

It should, of course, not be inferred that it is better to operate a lamp at variable temperature because the efficiency is higher on the basis of the production of a given intensity. For all practical cases the ratio is so nearly unity that it is of no commercial consequence, but the slight difference is really in favor of constant temperature conditions, for the lamp would show a shorter life on variable temperature operation. In other words, if the proper operating efficiency be defined as that to allow a given life, that for constant temperatures is unquestionably higher. The effect of the variation of temperature on life may be obtained by an integration of the so-called correction factor as figured by a well-established relation between candle-power (expressed as its ratio to normal) and efficiency, leaving out of account the effect which may be due to the reversals of current as in the case of tantalum. This shows for the case of an 11 per cent change above and below normal candle-power, as is approximately true for the 25-watt tungsten-filament lamp on 60 cycles, a reduction in life of 4 per cent, which, of course, is far in excess of the change in efficiency.

The curves as presented by Messrs. Kiely and Wasserboehr

are for a wave of voltage closely approximating a sine. The effect of a peaked wave would probably be to increase very slightly the amplitude of the variation of candle-power. There is good reason to believe that the increase of amplitude would be inappreciable at ordinary frequencies. The author hopes later to investigate the effect of the wave shape on the amplitude of candle-power, at which time, by the methods of this paper, the effects on efficiency and life may be determined. An effect which will produce a higher efficiency will of necessity produce a shortening of the life. It can hardly be expected that either will be of sufficient magnitude to allow of easy determination by direct test.

ELECTRICITY ON FARMS IN NEW YORK STATE.

Water-powers on small streams in New York State afford the means of bringing many electrical conveniences and labor-saving appliances to neighboring farm homes. An interesting account of some of these farm water-power installations is contained in an illustrated report, "Water-Power for the Farm and Country Homes," prepared by David R. Cooper, engineer-secretary for the New York State Water Supply Commission. After directing attention to the many small streams which might be harnessed to do useful work the report enumerates some of the uses for electrical energy on the farm, mentioning lighting, feed grinding, root cutting, fanning, grinding, sawing, hoisting, drilling, ensilage cutting, clipping, cream-separating, churning, vacuum cleaning, mixing, etc., besides the domestic purposes of the ordinary home.

Examples of actual work done by electric power are given as follows:

A 6-hp motor will thresh 250 bu. of oats, grind 20 bu. of corn, grind 48 bu. of feed, grind and press 250 bu. of apples or saw seven cords of hard-oak stovewood an hour, in the last instance taxing the ability of four men to stack the wood in cords as fast as it is sawed. A 12-hp motor driving a 50-in. circular saw will cut 4000 ft. of oak or 5000 ft. of poplar lumber in a day. A 10-hp motor running a 16-in. ensilage cutter and blower will deliver ensilage into a 30-ft. silo at the rate of 7 tons per hour. A 1-hp motor will supply water for ordinary farmhouse uses. From the up-State New York farm installations described in the report the following data are abstracted:

The 100-acre farm of Mr. E. B. Miner, near Oriskany Falls, Oneida County, N. Y., is devoted to hop raising, mixed farming and dairying. The sons of the family studied engineering at college and, becoming convinced of the possible uses of the stream near their homes, designed and built the 17-hp water-power plant and dam which now lights the farm buildings and saves many chores. This timber-crib dam, 36 ft. long and raising the water 4 ft., is carried on heavy concrete sills cast in a 2-ft. x 1.5-ft. ditch dug across the stream bed. Above the dam crest is a row of 1-ft. flashboards held erect by chains locked by pins which can be withdrawn by a capstan, dropping the boards in case of high water. There is also a supplementary 40-ft. spillway, with crest a few inches higher than the main dam, helping to discharge heavy floods. From the dam a 60-ft. canal and forebay leads downstream to the power house, where a vertical-shaft 17-hp turbine wheel is installed. A double pulley arrangement increases the speed of the water-wheel's rotation to the 1100 r.p.m. required by the 12.5-kw belted generator at the far end of the 12-ft. x 16-ft. power house. At this point Oriskany Creek drains 14 sq. miles, furnishing throughout nearly all the year tne flow of 2900 cu. ft. per second required to drive the water-power plant at full load under the available head of 6 ft. From the power house to the farm buildings, 1700 ft. distant, an aluminum-wire line is carried on 20-ft. poles set at 100-ft. intervals. The energy thus delivered is used to operate a circular saw, machine lathe and drill press, vacuum-cleaning system (used also for operating milking machines in the twenty-five-stall cow barn), cream separator, churn, grindstone, ventilating and cooling fans, electric iron, sewing machine, egg beater and water pump. The house is also warmed by five electric heaters, maintaining an indoor temperature of 75 deg. when it is zero outside. The water-wheel and generator run continuously, night and day, and self-oiling attachments make the plant require little attention. Mr. Miner says the water-power is worth to him several times its cost, which he does not state, but which engineers estimate to have been about $1,800 complete for dam, power house, line and equipment.

Mr. Stephen Loines, of Brooklyn, has a summer home on the shore of Lake George, his property including a seven-acre pond at an elevation of 180 ft. above the lake. The outlet of this body of water is caught in a 6-in. spiral riveted pipe and conveyed 1600 ft. down a gulley to the little power house, which contains a 10-hp, 24-in. impulse wheel operating under a 165-ft. head. The 6.5-kw generator delivers energy to a sixty-cell house-lighting battery, an eighty-four-cell battery for a 35-ft. cabin launch, a forty-eight-cell battery for a 20-ft. open launch, and a forty-cell battery for an electric roadster, all of which are in nearly continuous use five months in the year. Another development on the estate comprises a 2-in. pipe with a fall of 110 ft. in its 1200-ft. length, operating a 3-hp impulse wheel used to drive a saw belted directly to the shaft. An unusual use of hydroelectric energy on the Loines estate is the operation of the roof of the private astronomical observatory just above the cottage. The dome roof is mounted on wheels and is moved by a 1.5-hp motor.

Mr. J. Van Wagenen, of Lawyersville, Schoharie County, N. Y., a practical and scientific farmer, utilizes the 15-ft. head created by an old disused sawmill dam. His 5-hp water-wheel is belted to a 3-kw, 125-volt generator, the output of which is conveyed over 3700 ft. of pole line to the houses of the owner and a neighbor. As it was undesirable to visit the plant, half a mile away, night and morning to stop and start the turbine, as well as inadvisable to waste water during the dry season by letting the plant run all the time, the turbine valve has been attached to a pull-wire extending to the bedroom window of a neighbor living 700 ft. distant. Pulling this wire at 5 a. m. starts the plant, and releasing it at night allows a counterweight to drop, turning off the water. For this service of starting and stopping the machine the neighbor gets his electric service free for his house and barn. The plant maintenance has been trifling. The owner wired his house at a cost of $40 for material, doing the work himself. The plant cost a little over $500, the dam being already built and most of the installation work being done by the owner at odd hours:

Dynamo, 3 kw (second-hand)	$50
Water-wheel, 9 kw (naked wheel)	5[illegible]
Governor (new)	7[illegible]
Wire (7,400 ft.)	21[illegible]
Labor (installing water-wheel)	[illegible]
Fixtures (lamps and the like)	38
One small motor, 2 hp (new)	50
Total	$518

Such a water-power plant Mr. Van Wagenen declares to be equivalent to a hired man's services, doing away with many chores and laborious duties about the place.

Mr. J. T. McDonald has a farm near Delhi, N. Y., which is equipped with three water-wheels utilizing the 15-ft. head created by a dam and 900-ft. raceway. A 25-hp turbine runs a sawmill and feed mill; a 3-hp wheel runs small saws and machine tools, and a 6-hp wheel drives the electric generator. The turbine gate is opened and closed by a switch in the owner's house, while the field circuit and rheostat are brought to the same point, enabling the voltage to be regulated closely.

Mr. Frank Caspar, in Schoharie County, has a turbine water-wheel driving a generator which lights a furniture factory, church, village street and his own home. The plant is started and stopped by a pull-wire which opens a small valve admitting water pressure to a cylinder, the piston of which operates the gate.

In addition to a 36-in. impulse wheel operating under a 210-ft. head and driving a sawmill on the place of Mr. Arthur Cowee, near Berlin, N. Y., a smaller impulse wheel is direct-connected to a 3-kw generator supplying electricity to 160 lamps

The penstock for the main wheel is a 10-in. cast-iron pipe, 1680 ft. long.

One of the largest farm water-power installations is that at the 5160-acre farm, "Heart's Delight," of Mr. W. H. Miner, the output of which is live stock, poultry and dairy products for high-class city hotels. All crops raised on the farm are fed directly to the stock. The smaller water-power source is a group of three small dams built across Tracy Brook to create storage reservoirs. From the lowest of these a 44-in. penstock, 670 ft. long, carries the water to the power house under a 19-ft. head. Here two turbines of 30-kw and 12.5-kw capacity respectively are installed, driving 220-volt, direct-current generators. Another concrete dam is built across the Chazy River, the water being led through a concrete penstock, 48 in. x 60 in. in section and 630 ft. long, to a second power house, where a fall of 30 ft. is obtained. Here two turbines drive alternators, the output of which is conducted to the central farm buildings, three miles distant. Hydraulic rams are also used for water pumping on this farm. In all twenty-five motors are installed for the variety of purposes mentioned in the foregoing, since nearly every modern use of electricity is employed on this farm.

The report closes with a discussion of some of the considerations involved in constructing a small water-power plant.

Central Station
Management, Policies and Commercial Methods

VOLTAGE RELAY CHANGES TRANSFORMER RATIO AT DISTANT MOTOR INSTALLATION.

The Toledo Railways & Light Company supplies energy to the 1200-kw motor load and 300-kw lighting load of the Toledo factory of the Overland Automobile Company, which is nearly three miles distant from the generating station. As the voltage regulation at the distant end of the 4000-2300-volt line transmitting this heavy combined motor and lighting service was found to be inferior for lighting purposes, it was necessary to devise means of holding the secondary pressure at the factory more nearly uniform, without involving the expense of an induction regulator. A potential relay has been accordingly arranged to close when the factory-line pressure drops below 109 volts or 108 volts, energizing a magnet the armature of which releases a weight. In falling this weight operates a switchblade transferring the line connection from the 2300-volt terminals of the transformer primaries to 2080-volt taps brought out from the winding, restoring the secondary pressure again to its normal value, 115 volts. This automatic regulation is applied, of course, only to the six 50-kw lighting transformers, and as installed in the Toledo instance has to be replaced by hand when the line pressure rises.

TUNGSTEN LAMPS AND DEFECTIVE VOLTAGE REGULATION.

Since tungsten lamps have come into general use central-station companies which have large numbers of these lamps on their lines are enjoying some benefits not generally recognized. With carbon lamps it was not infrequently the case that consumers used the least amount of light they could get along with. The candle-power of lamps installed would be cut down closely to fit the absolute needs and necessities of the user because of the expense of operation. The result of this was that if a central-station company allowed its voltage to get below normal the fact was soon painfully apparent in lack of satisfactory light at the consumers' premises. Much dissatisfaction with the service and loss of business has resulted from abnormally low voltages. The actual voltage maintained at the lamps varies much more than is commonly supposed in the great majority of central-station and isolated plants.

With tungsten lamps conditions have been somewhat changed by the fact that consumers have usually installed a sufficient candle-power of tungsten lamps to give more than barely enough light. Consequently when the voltage has been below normal the customer has not realized the fact and has considered his service as fairly satisfactory. Of course, too, the fact that the tungsten lamp does not decrease in candle-power as much for a given percentage of lowering in voltage as the carbon lamp has had a helpful influence. On a certain central-station distributing system recently some very surprising results were obtained by testing the voltage during peak load at various points. In general, there were many places where the voltage was considerably below the normal at which it was supposed to be maintained, yet this service, as far as the customers were concerned, was considered very satisfactory, and the existence of the low voltage had not been suspected before the voltmeter tests were made. There is an old saying among electrical men that "human voltmeters are not reliable." In other words, it is impossible to judge of the voltage on the circuit by looking at the lamp filament. Nevertheless, since lighting service is the object of maintaining voltage, voltage conditions cannot be so very bad if the service, from the standpoint of the customer, is thoroughly satisfactory. From this it is not to be concluded that we recommend that central-station companies relax their vigilance to maintain voltage at consumers' lamps as near normal as possible.

FEBRUARY MEETING COMMONWEALTH EDISON N. E. L. A. BRANCH.

The Commonwealth Edison branch of the National Electric Light Association in Chicago held its regular meeting on Feb. 7 at Auditorium Recital Hall, when a program was given which was both entertaining and instructive. Three brief papers were presented. Mr. F. J. Arnold described the methods of the engineering department of the Commonwealth Edison Company. This department consists of fifty-seven members. In it the plans are made for all new work. When new work is contemplated the first thing is an estimate of its cost for the budget. When this is passed upon and approved by the president and directors the statistical department makes an entry of the preliminary estimates, after which the engineering department goes ahead with plans and detailed estimates. This department is under Mr. R. F. Schuchardt, electrical engineer.

Mr. A. G. DeClerq, after an amusing running commentary on the papers that had been presented to the branch on the various departments of the company's work, took up the work of the construction department. Men in this department are always subject to call for emergencies at any hour, day or night, and may have to work many hours continuously when on a repair job. When at work they depend very largely for their safety on the care and vigilance of others. He gave the methods of handling various work orders. Some of these orders come from the operating department, some from the contracting department and some from the engineering department. This department is under the management of Mr. J. H. Goehst.

Mr. C. J. Hejda described the work of the testing department, which was started thirteen years ago with two men. This department is divided into general testing, meter testing and chemical testing. It furnishes and calibrates all of the instruments used by the construction department in new work and maintains the accuracy of instruments in use.

Following the papers a five-minute intermission for social purposes was given, after which Mr. John Manley opened the discussion with some interesting facts about the construction department and its work. He said that the methods in use in the direct-current low-tension work were practically those worked out twenty years ago by Mr. L. A. Ferguson, now second vice-president, no better methods having been evolved. He then spoke of the fine work done by the house-wiring department, in which some of the finest residences in Chicago are rewired without serious disturbance of the contents or occupants. After some more discussion a glee club of eighteen members furnished some music, illustrated from time to time with stereopticon cartoons. Miss Booth sang two solos accompanied by a string quartet, and Mr. J. W. Ferguson told some of his entertaining stories. It was announced that the membership of the Commonwealth Edison branch had reached 790. About 400 were in attendance at this meeting.

ANTI-GASOLINE CAMPAIGN IN COLORADO.

Mr. F. D. Morris, Colorado Springs, Col., secretary of the Colorado Electric Light, Power & Railway Association, has mailed to every gasoline user in the State a copy of the illustrated account of the gasoline lighting outfit explosion in a St. Louis poolroom published in the *Electrical World*, Jan. 5, and reprinted in the Colorado Springs *Gazette*, Jan. 27, accompanied by some remarks by Mr. C. L. Reasoner, city electrician of Colorado Springs, in which he pointed out that defective gasoline systems endanger property and imperil lives. Central-station men commenting on this account of a typical gasoline explosion have declared it to constitute one of the best arguments against gasoline lighting ever published, and widespread distribution has been given the item in Colorado, so that all the central stations of that State may profit.

RELATIONS WITH THE PUBLIC.

Under the title "Franchises" Mr. Arthur S. Huey, vice-president of H. M. Byllesby & Company, Chicago, read an interesting paper at the recent convention of Byllesby companies in Chicago. Mr. Huey gave candid consideration to the relations of the public-service company and its community, and, speaking for his own organization, said: "We prefer to hold our franchises by retaining the confidence of the people; to hold the privileges conferred by the public not by right of law but by right of merit." A little later he said:

"When I urge upon each one of you to look upon your franchise as a trusteeship to be administered in the interests not only of your company, but of the people, I view the matter from a business point of view and speak as a business man. The interests of the people and of utility corporations are interwoven. The city needs the utility; the utility is non-existent without the city. The prosperity of a city demands a wholesome growth; the opportunity for utility earnings likewise requires this growth. Good service and fair rates promote the welfare of the public. Use of the service offered determines the welfare of the company."

The speaker made a list of what may be regarded as the principal obligations of both parties to a franchise. The obligations of the utility company include the following:

First—Rendering of good, adequate and continuous service. Second—Fair and reasonable rate schedules. Third—No discrimination among customers of the same class, or between classes of customers for like service. Fourth—Extension of service into all populated sections of the municipality and suburbs. Fifth—Earnest endeavor to market the greatest possible volume of service. Sixth—Adoption of approved inventions and developments in machinery and apparatus. Seventh—Sound financial management. Eighth—A high standard of physical maintenance. Ninth—Public-spirited attitude in all matters concerning the general welfare and advancement of the community. Tenth—Broad and liberal business administration. Eleventh—Keeping faith with the people in all agreements, promises and announcements. Twelfth—Strict obedience to law, and no participation in politics.

Mr. Huey enlarged on his subject at considerable length. One of his striking observations is as follows: "In few lines of endeavor do petty practices cost so dearly as they do in the operation of public utilities. It is suicidal to adopt a policy bounded by the straight-laced terms of contract and franchise, cap-sheafed by the motto, 'We don't have to.' The 'we-don't-have-to' spirit, gentlemen, has caused unmeasured and well-deserved woe to public-utility corporations. It was one of the mortal sins of the old-time operator, and we of the present day are still doing penance for its commission."

Considerable attention was paid by the speaker to the development of natural resources; and in relation to this subject, and, indeed, in the conduct of all public utilities, he believes that fair-minded consideration of the question will convince any commission or other public body that a liberal compensation is deserved by the private capital invested in the enterprise.

Summing up, Mr. Huey said that if the management is progressive and conducts its business as a public trust the terms of its franchise matter little. On the other hand, if the management refuses to recognize the equity of the public and declines to be liberal and fair, that management will go down to merited defeat and financial loss, regardless of the most liberal franchise every granted.

THE STORY OF A CREEK.

There is a creek running through the village of Gowanda, N. Y., and thereon hangs a tale. When this creek started out to make a place for itself in this world it wasn't a creek, it was merely a trickle. By and by it picked up another trickle or two and resolved then and there to become a rivulet. Puffed up with ambition, one fine spring morning it suddenly turned into a creek and ever after it was called Cattaraugus. From this creek the Keyes Electric Company generates its electricity, and in a neatly printed and cleverly written booklet it tells the people of Gowanda what a great streak of liquid it is and what a high grade of electricity it produces. The uses to which this electricity can be put in the household, factory, store or office are nicely pointed out, and without jarring on the sensibilities of the reader the company says that it wants him to know that it is ready to install for him or any one a service of the modern electric devices that add to the measure of human comfort. Gowanda has a population of less than 3000, so that as far as central stations go that of the Keyes Electric Company would not be considered large. Its advertising literature, however, outclasses much of that issued by companies in cities a hundred and even a thousand times as large.

CENTRAL-STATION PROBLEMS IN GERMANY.

Comparing from an economic standpoint the manufacture of electrical apparatus with the production and distribution of electrical energy in Germany and Austria, Dr. C. Kinzbrunner, writing in the *Elektrotechnische Zeitschrift*, Sept. 29, 1910, says that the attentive observer will note an essential difference in organization in the two industries. Manufacturing, he says, is not only technically further developed, but even the sales end of the great German concerns leaves little to be desired. They proceed generally from the sound business standpoint that today, where manufacture has reached a certain degree of completeness, the center of gravity of business must lie in the sales organization. And this with right, for a good business man will always be in position to sell a little-desired article, and in this wise obtain results—even if only slightly productive—while, as a rule, the most skilled engineer is seldom able to sell even a very good article.

Strangely enough, the relations in the case of central sta-

tions are essentially different. Here there has always been and is to-day an extremely lively development in relation to technical results. The most painstaking care is applied to the cheapening of the product (electrical energy), to surety of action and, indeed, in esthetic sense, to the outer appearance of the structure. But the business and sales organizations of most stations are in bad condition. How many central stations in Germany and Austria make a study of methods for the spread and extension of the use of electricity in their district? How many have at the head of their sales organizations an unfettered chief, who employs trained sales representatives? No manufacturer would concentrate all his work and endeavors on the betterment and cheapening of his products, leaving their sale to chance, but yet there is in Germany and Austria to-day a large number of electric stations that are organized in this way, quite out of joint with the times. Where they could earn an extra mark ($0.25) they are satisfied with saving a pfennig ($0.0025).

As is well known, the introduction of metal-filament lamps has rendered the position of many electrical stations difficult, especially those supplying energy chiefly for lighting purposes. In spite of the increase in the number of consumers and connections, the number of kw-hours consumed remains constant only under most favorable conditions, and actually decreases in many cases. Furthermore, this condition will not be changed until the majority of consumers have gone over to metal-filament illumination, which at the present time is not the case.

It is significant that a decrease of kw-hour consumption is required to cause the heads of many electrical stations to ponder ways and means whereby a greater consumption could be obtained. At this juncture, then, becomes evident in many establishments the lack of a modern business organization.

From an economic standpoint the majority of stations suffer from two defects. First of these is the non-uniform and insufficient use of distribution lines, the high installation cost of which influences dividend capacity. Since this generally occurs in poorer cities and districts, the increase in the consumption depends on the cheapening of the individual house installation, cheaper production or pro-rata decrease in the initial charges. It is also in just such districts that enlightenment of the public to the hygienic esthetic and economic advantages of electric illumination is insistently required.

The second great economic defect is the small load-factor and the disproportionately large demand during the evening hours in the winter months, resulting in unequal division of consumption. Even though much has been done toward the betterment of the load-factor, still the fact must not be lost sight of that this is a pressing economic problem for the solution of which the technician, salesman and organizer are required. The engineer and operator are only too easily inclined to regard the small load-factor as an unavoidable fact; not so with the salesman, who knows of operation only as much as is absolutely necessary. He would regard it as unbelievable that, for example, of the 8760 working hours of an electric station the proportionately great installation charges should be fully utilized only during some hundred hours, for the entire remaining time lying more or less idle. The engineer of an electric station with a load-factor of about 15 per cent and a fuel consumption of, for example, 4 pfennigs per kw-hour will generally regard as well spent an investment of some thousand marks whereby the fuel consumption could be diminished to 3.5 pfennigs. The salesman, or the commercially inclined engineer, will, however, prefer in many cases to spend the same amount for the betterment of the load-factor and in this way increase the dividend capacity of the station more than was possible by diminution of fuel consumption.

One of the greatest difficulties which oppose the introduction of electric service, especially in the smaller city quarters, is the cost of installation. Petroleum oil lamps are cheap and require no installation. Gas has the great advantage of very small installation cost; in addiiton, it happens that the gas works do their utmost to make the installation costs as small as possible or even in many cases bear them themselves.

Greatest are the difficulties in the case of electric light. The interests here are unfortunately much divided. The contractor, who is quite independent of the central station, has naturally the greatest interest in selling his customer as much as possible and at a high price. In spite of this an electric installation can be put in which will correspond to all the demands of safety and at the same time not be essentially higher in price than an equally good gas installation, but the general public is usually frightened at the cost of installation, and properly so. Therefore, many a contractor prefers giving over the installation entirely to laying it out as simply and cheaply as possible and selling to his customer cheap but effective fixtures. Where it is a question of extending consumption in the poorer districts the costs of installation are either divided pro rata, or, as generally brings good results, the consumer pays a rate for his lighting which covers the cost of installation in the course of the first year. The central station has hitherto done all too little to aid the poorer consumer in the introduction of electricity by either the greatest possible reduction of installation expense or its complete removal.

A special kind of advertising for the extension of electricity in the household could also be effected by the contractors and builders. This class is generally better instructed in the application of gas than electricity, and here is opportunity for skilful action on the part of the electric interests.

Electric cooking has an especial significance in improving the station load-factor in Germany, where in the middle-class and smaller households the principal meals of the day occur in the morning and mid-day hours, when consumption for lighting is insignificant. The importance of the most rapid extension of electric cooking can scarcely be overestimated. In addition to this, it happens that where, besides electric cook stoves, coal and gas are reserved for use electricity will receive the preference without question in summer.

Wiring and Illumination

FIXED PRICES PER OUTLET FOR WIRING.

For many years no electrical contractor who made any claim to giving close estimates on wiring jobs would have thought of taking a job at a certain price per outlet, looking at the building and the possible difficulties to be encountered. Nevertheless there is a marked and commendable tendency at the present time in various cities for central-station companies and contractors to get together and agree upon a certain unit price per outlet for wiring in certain specified classes of buildings, especially residences. The plan has much to commend it and its advantages should be thoroughly considered. Considering the matter first from the contractor's standpoint, it is evident that a considerable amount must be added to the cost of any small job for the time taken in preliminary work and estimates.

Now, if a number of buildings, for example, residences of a certain height and floor construction, are wired and the average price for each kind of outlet is determined as a result of experience, it has been found feasible to establish certain prices per outlet based on this experience and take jobs accordingly without detail figuring on particular cases. In other words, the contractor may lose a little money on some particular house, but it will be made up in the average run of the business and in the meantime he will be saving the cost of preliminary figuring and estimating. It is especially desirable to eliminate these preliminary costs on small residences where the price of the complete job must be brought down to the lowest figure possible in order to get the business in large quantities. It has been the custom of central-station companies in some cities for several years to establish schedules of prices for the wiring of houses, either on the cash or instalment plan. This wiring would either be carried out by the central-station company or

by local contractors who had agreed to the schedule of prices made.

From the business-getting standpoint the plan has decided advantages because it enables the contractor to tell the prospective consumer on the spot the cost of wiring his building without the necessity for delay in getting figures and a second interview. If the central-station company is not in the contracting business and the central-station solicitor has to tell the consumer that he will have to wait for prices from some contractor the consumer's enthusiasm is likely to die out and the wiring of his building be put off indefinitely. The same is true in regard to minor improvements in lighting which the central-station man can frequently suggest. The first question the customer usually asks about changes of this kind is, "How much will it cost?"

Of course, there is much work where any conservative contractor will want to figure individually, but for the wholesale wiring of ordinary small buildings the adoption of certain unit prices which can be applied to the class of building as a whole undoubtedly is a help to getting business. The same is true of prices for making common alterations for the use of tungsten instead of carbon lamps. For example, many rooms are equipped with fixtures hanging low, and when tungsten lamps are adopted a single lamp placed high and controlled either with a pendent switch or a wall switch would be desirable. Established prices for making this kind of a charge might well be made and advertised.

MEASUREMENTS OF INTRINSIC BRIGHTNESS BY A NEW METHOD.

By Herbert E. Ives and M. Luckiesh.

The fact that the candle-power per unit of area of most artificial light sources is many times that of the sky or a white sunlit surface has been known for some time. Sufficient comment has been made upon the consequent ill-effects of exposing the eye to bare lamp filaments to render unnecessary a discussion of that phase of the matter here. Various tables have been published from time to time, presumably calculated from the dimensions and the candle-power.

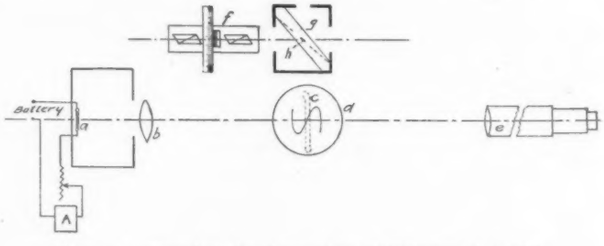
A piece of apparatus constructed for a somewhat different purpose has lent itself to the making of measurements of intrinsic brightness in a more direct manner than any hitherto known to the writers. The method is applicable to cases where the measurement of dimensions in connection with candle-power is not easy and so has made possible the collection of some hitherto undetermined data. In general the values given in previously published tables are confirmed as to order of magnitude. However, some interesting exceptions occur, and these, together with the details of the method, warrant some description.

The instrument used is a modification of the Holborn-Kurlbaum optical pyrometer. In this latter instrument the furnace or surface the temperature of which is to be measured is viewed directly, while between the eye and the object is placed an incandescent lamp filament. The current in the filament is varied until the filament becomes invisible—that is, until its intrinsic brightness is the same as the background. A previous calibration of the filament on a "black body" makes it possible to state this intrinsic brightness in terms of "black-body temperature," or the temperature the filament (or background) would have if of the same emissivity as a black body. A temperature measurement with this instrument might, however, be expressed in terms of brightness per unit of area if desired. To accomplish this use could be made of the data of Nernst* on the candle-power per square millimeter of a black body at various temperatures.

In attempting to apply this method of measuring intrinsic brightness to the measurement of illuminants the usual conditions are reversed. That is, instead of having a background of large extent, against which the auxiliary lamp filament may be matched, the surfaces to be measured are often of very small dimensions. For instance, an incandescent lamp filament is so small that the attempt to match one with the brightness of another filament crossing it is altogether impracticable. Magnification helps little here, as the magnification must be so large that only lamps in specially made bulbs with plate-glass windows, causing no distortion, could be employed. This would prevent the use of the pyrometer as made. It might be thought, however, that the filament to be measured could be substituted for the pyrometer lamp and a "black-body" furnace used for background. The obstacle to this is the high intrinsic brightness of certain of the lamp filaments, which would necessitate operating a black body at temperatures much above those ordinarily used and only practicable, if at all, with furnaces of specially refractory material.

These various difficulties are very satisfactorily overcome by a background chosen after some search, namely, the *image of a Nernst glower*. In the first place, the glower happens to have a higher intrinsic brightness than any of the incandescent filaments. In the second place, since it is operated in the air, and not in a bulb, an image may be formed by a lens without distortion. In the third place, the ordinary commercial glower is large enough so that only a few-fold magnification is necessary.

A few words are necessary in regard to the use of an image as a background. It follows from geometrical optics that the intrinsic brightness of an image in space, as viewed from the side away from the lens forming it, is equal to the brightness of the original source, provided the beam of light entirely fills the pupil of the eye or the aperture of the telescope with which the image is viewed. Consequently, an image of any convenient size may be used and it may be focused in any plane desired, such for instance as that of a lamp filament in a bulb. In the latter case the relative position of filament, lens and bulb is such that no troublesome distortion is introduced by the glass of the bulb.



Plan of Apparatus for Measuring Brightness of Light.

It must be clearly understood that this peculiarity of the brightness of an image holds only if the image is in space and is viewed from behind—that is, it would not hold if the image were formed on a diffusing surface, when the brightness would vary with the size. As a practical qualification to the general statement is the necessity of taking into account the absorption of the lens which forms the image, as will be noted.

A plan of the apparatus is shown in the accompanying illustration, where *a* is the Nernst glower inclosed in a tin box to avoid drafts. For this work a direct-current, 0.6 amp glower was used, without the heating coil. No ballast was used, but the voltage was cut down from 140 to the normal (115) by resistances. Current was read by the ammeter *A*; *b* is the lens, in this case a Hasting's triplet of 2-in. focus; *c* is the enlarged image of the glower, in the plane of *d*, the incandescent lamp to be measured, and *e* is the observing telescope.

In order to make measurements it is obviously necessary to vary the brightness of the Nernst image and to know the values of this brightness. Several means of changing the candle-power of the Nernst were tried, and finally two were employed, each for a different range. In measuring the incandescent lamps it was found most satisfactory to change the Nernst by varying the current through it. Separate photometer measurements gave the relationship between current and brightness in the glower. This means of varying the brightness could not be used for low values (below 200 cp per square inch) owing

Phys. Zeit., pp. 380-383: June 1, 1906.

to the failure of the glower to operate. For other illuminants of lower intrinsic brightness a pair of nicol prisms, *f*, were inserted. Their angle of rotation relative to each other could be read; when a setting was made each side of the extinction point (Θ_1 and Θ_2) the brightness of the glower image was $a \sin^2 \frac{\Theta_2 - \Theta_1}{2}$, where *a* is the transmission of the nicol prisms at their point of maximum transmission. This formed a very satisfactory method for varying the brightness of the background and would have been preferable throughout were it not that the absorption of the nicol prisms reduces the background intensity below the value necessary for matching the lamp filaments at their normal operation.

For the measurement of flames and other illuminants of an extended character it was necessary to introduce an auxiliary device. Clearly, flames, being transparent, cannot be matched against a bright background, and similar or equally great difficulties arise with certain of the other illuminants. For the purpose of measuring these a thin reflecting filament was made, consisting of a ½-mm strip of silver, *h*, chemically deposited on the back of a 7-deg. prism. Against this a second prism was cemented with Canada balsam, so that the outer faces of the prisms were parallel, but at an angle with the silver strip. This compound prism was inclosed in a small box, *g*, with front, back and a narrow side opening. By this means all reflections except those from the silver strip were invisible at the telescope. Portions of flames reflected in this strip appear very much like the lamp filaments and disappear very satisfactorily against the background.

Certain constants of the instrument had to be determined. The intrinsic brightness of the Nernst was obtained by measuring the candle-power of a portion of the center of the glower, the ends being covered by a metal diaphragm. The width of the opening and the diameter of the filament (hot) were measured with a micrometer microscope; the candle-power divided by the area gave the desired value at the current used. A candle-power-current curve gave the value of this quantity at other currents.

The absorption of the lens, *b*, was determined in the following manner: A similar lens was first used to form an image of the glower of a convenient size. This was matched against a filament. The original lens was then placed next the second one and an image formed similar to the first. This was matched against the filament by changing the current through the latter. A measurement of the relative brightness of the incandescent lamp in the two cases made possible the determination of the transmission of the lens used.

By a similar method the absorption of a single thickness of lamp bulb was determined. The reflecting power of the silver strip was determined by substituting for it a first-surface platinum mirror, with a sharp edge, the reflecting power of which was known. Measurement was made of the intrinsic brightness of an opal glass in front of an incandescent lamp, using each mirror in turn. Their difference in reflecting power and the known reflecting power of the one gave the requisite data. The values of these constants as determined were: Transmission of lens, 90 per cent; of lamp bulb, 90 per cent; reflecting power of mirror, 73.5 per cent; maximum transmission of nicol prisms, 23.6 per cent.

The measurements were made in the manner indicated above, with few variations. All the electric illuminants were operated carefully at their correct commercial rating. The gas and oil illuminants were taken as they came. Several of the sources were of such character that it was necessary to measure them by projecting an image upon the silver strip. These were the Welsbach mantle (to secure a measurement of the mesh) and the carbon and magnetite arc lamps. This involved only the correction for the absorption of the additional lens. In the two latter cases neutral-tint absorption glasses were also necessary. Neutral-tint glasses were used over the eye-piece of the telescope when necessary to reduce the brightness of the image to a workable value.

In order to test the accuracy of the method a piece of flashed opal glass under a diaphragm was placed in front of a tantalum lamp and measured both directly upon a photometer and indirectly by means of the apparatus described. By direct measurement the value of the intrinsic brightness was 1.80 cp per square inch; with the apparatus it was 1.83, an agreement as close as could be expected. Similar measurements on a Welsbach mantle and values for a hairpin-filament carbon lamp of measured candle-power and projected area of filament showed nearly as good agreement, thereby indicating the method to be reliable.

Most of the measurements shown are the mean of several sets made at different times. In the case of the incandescent lamps the figures are the mean of measurements on the several filaments of the metallic-filament lamps or parts of the one filament in the carbon lamp. Differences of as much as 10 per cent have been noted in one lamp at different points in the same filament all well away from the end connections. The method furnishes, in fact, a very sensitive "spot test." The least satisfactory of the figures given are those for the carbon and magnetite arc lamps, due to extreme difficulty in maintaining their images steadily upon the reflecting strip. The use of a wider strip, in which the whole image could be watched, would probably largely overcome this difficulty. The Cooper Hewitt mercury-arc lamps had been operated for several hundred hours and the tube was somewhat blackened.

The values obtained in the present investigation are given in the accompanying table, together with some values given by Barrows* for comparison. These latter values appear to be in part selected from previously published values by others and render unnecessary quoting other tables. As given, the incandescent lamp values determined by the authors refer to the brightness *inside the bulb*; they will be about 10 per cent less as ordinarily viewed.

Source.	Barrows.	Ives & Luckiesh.	
	Candle-Power per Square Inch.	Candle-Power per Square Inch.	Candle-Power per Square Mm.
Sun at zenith	600,000	....	....
Crater, carbon arc	200,000	84,000	130.
Open carbon arc	10,000–50,000	....	....
Flaming arc	5,000	....	....
Magnetite arc	.....	4,000	6.2
Nernst glower	800–1,000	....	....
Nernst glower (115-volt, 6-amp. d. c.)	.....	3,010	4.7
Incandescent lamps:			
Tungsten, 1.25 w.p.c.	1,000	1,060	1.64
Graphitized carbon filament, 2.5 w.p.c.	625	750	1.2
Tantalum, 2.0 w.p.c.	750	580	0.9
Carbon, 3.1 w.p.c.	480	485	0.75
Carbon, 3.5 w.p.c.	375	400	0.63
Carbon, 4.0 w.p.c.	300	325	0.50
Inclosed carbon arc (d.c.)	100–500	....	....
Acetylene flame	75–100	....	....
Acetylene flame (1-ft. burner)	.....	53.0	0.082
Acetylene flame (½-ft. burner)	.....	33.0	0.057
Welsbach mantle	20–25	31.0	0.048
Welsbach (mesh)	.....	56.0	0.067
Cooper Hewitt mercury-vapor lamp	16.7	14.9	0.023
Kerosene flame	4–8	9.	0.014
Candle flame	3–4	....	....
Gas flame (fishtail)	3–8	2.7	0.004
Frosted incandescent lamp	4–8	....	....
25-watt frosted tungsten lamp:			
Tip	.....	1.67	0.0026
Side	.....	6.00	0.0093
Moore carbon-dioxide tube lamp	0.6	....	....

It will be seen that the values here given agree well with those given by Barrows, with the noticeable exception of the tantalum and graphitized carbon filament. The new values, which have been carefully checked on several lamps, indicate a higher intrinsic brightness for the graphitized carbon than for the tantalum. There is nothing strange in this, for there is no question that, at the same temperature, carbon, because of its relatively non-metallic "black" character and consequent high emissivity, would be much brighter than the metal tantalum. There is found here an illustration of the fact often not grasped

*Barrows, "Electrical Illuminating Engineering," p. 3.

that efficiency does not depend upon high emissive power (which would place carbon above the metals), but upon the relative emissive power and hence the relative amount of radiation in the infra-red and in the visible spectrum. The emissivity of the graphitized carbon filament is so much higher than the emissivity of the tantalum that even at a lower efficiency the intrinsic brightness is higher.

The variety of illuminants that were measured shows the general applicability of the method. Among other figures those of the Welsbach mantle might be especially noted, for both measurements of the mantle as a whole and of the incandescent fibers separately are given. The latter were obtained by forming an image of the mantle upon the silver reflecting strip.

Some improvements in the apparatus might profitably be made as a result of experience with these measurements. Chief among these would be the use of some other background. The direct-current Nernst glower proved a somewhat fragile tool for the usage dictated by this experimental method. A thick tungsten filament in a fairly flat and uniform or large diameter bulb would be preferable. It could be safely overrun sufficiently to match filaments of the same material, while the other filaments would match it at its normal voltage or below. In the event of using a filament of this type a purely substitution method would be advisable, referring all measurements to a filament of known brightness, itself matched against the special tungsten background.

These modifications of the procedure here used would be well to follow were intrinsic brightness measurements found of such use in any photometric method as to make convenience in obtaining them of practical importance—which is not anticipated. As a matter of fact, the present apparatus was devised to test the possibility of rating incandescent lamps at a uniform specific consumption by setting them at the same intrinsic brightness. The method has been found good, but unfortunately *too good* for commercial incandescent lamps. These, as mentioned above, vary from filament to filament and from point to point on one filament by an amount corresponding to several volts. Further difficulties might have developed due to differences in vacuum or to differences in the character of the filament surfaces, depending upon their amount of seasoning; but the non-uniformity of the filaments sufficed to condemn the method. The apparatus, however, lent itself to intrinsic brightness measurements with the results tabulated above.

The authors wish to express their thanks to Mr. E. H. Bailey for assistance in making measurements.

RECENT TELEPHONE PATENTS.

LOADED PHANTOM.

The loaded-phantom telephone circuit has been looked to as the most accessible means of extending the long-distance range both commercially and from a transmission standpoint. From the transmission standpoint the range is largely dependent upon the effective cross-section of the conductors, but from the commercial standpoint the limit is evidently determined by the maximum investment that will allow of a practicable rate for service. The loading of lines with Pupin coils very materially increases the effective size of the conductor at a reasonable cost. Similarly the phantom doubles the conductor size by using two in parallel as one, i. e., two complete physical metallic circuits inter-connected so that they may each be used for an individual message and simultaneously used for a third superimposed message.

Unfortunately, heretofore two loaded circuits would not serve as a practicable phantom, as the loading coils through their magnetic and electrostatic leakages caused too great losses and cross-talk. These defects are partly due to the relative position of the load-coil windings to the core and casings of the coil, these forming condensers. They are also due to consequent magnetic poles formed at the junction of the two windings. Mr. Thomas Shaw, of Hackensack, N. J., has invented a load coil which overcomes both these difficulties. In his coil each winding is made in two parts, and one part of both windings covers one-half the toroidal core of iron wire. The inner section on one part of the core and the outer section on the other are associated and vice versa. With this arrangement the effective inductance to the physical circuit is little changed, while for the phantom, as the counterbalancing or differential

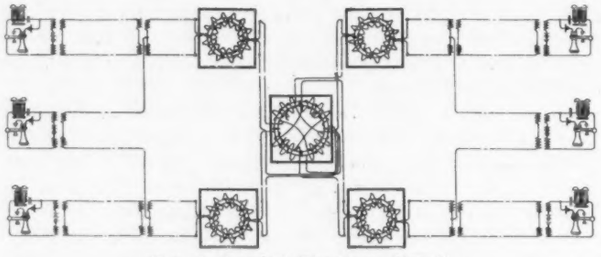


Fig. 1—Loaded Phantom Circuit.

effect of the overlapping winding is distributed over the entire core, there are no consequent poles formed. Again, by properly associating and arranging the inner and outer layers and abutting ends of the windings with respect to the line wires, the condenser effect may be made negligible as a producer of cross-talk.

A second patent, granted jointly to Mr. Thomas Shaw and Mr. G. A. Campbell, of Brooklyn, involves a means of loading phantom circuits. These may be composed of either loaded or non-loaded physical circuits. The phantom loading coils may be similar to those in the above-mentioned patent granted to Mr. Shaw, being, however, inductively arranged for two wires in parallel, or they may be a special four-circuit coil constructed upon similar principles. In the latter case one set of phantom-load coils suffices for both physicals, while in the former two sets are required, one set for each physical. Both these patents are assigned to the American Telephone & Telegraph Company. The accompanying illustration shows diagrammatically the preferred form of the loaded phantom of loaded physicals.

TELEPHONE AND TELEGRAPH SYSTEM.

The accompanying illustration shows a telephone and telegraph system invented and patented by Mr. H. O. Rugh, of Sandwich, Ill., his patent being assigned to the Sandwich Electric Company. The Wheatstone-bridge arrangement of resistances and inductances is the essential factor. Telegraph cur-

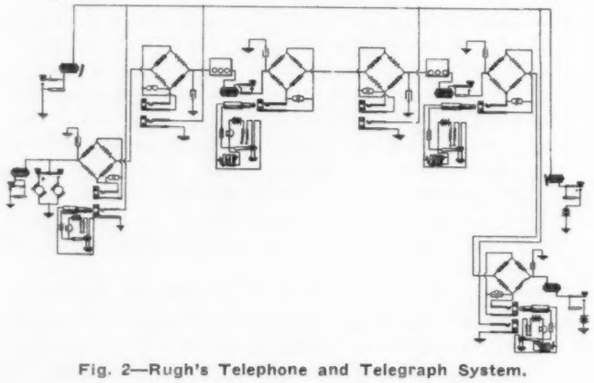


Fig. 2—Rugh's Telephone and Telegraph System.

rents traverse the arms in parallel so that the telephone taps are practically at equipotential points. Telephone currents, on the other hand, travel the non-inductive path. It will be seen that telephone stations may converse over the upper or through wire while adjacent stations are holding intermediate conversations over the telegraph circuit. The system contemplates a selective step-by-step signal and the use of the through line for telegraph purposes.

CALL-DISTRIBUTING SYSTEM.

In a telephone-exchange system patented by Mr. A. H. Dyson, of Chicago, and assigned to the Kellogg Switchboard & Supply Company, the call-distributing scheme of operation seems to be carried to well nigh its ultimate. Not only does the invention contemplate its use for "A" positions, but the principle is adapted to the trunking to "B" positions and distant exchanges. The "A" operators have before them signal lights and locking keys. When a station originates a call the calling line is associated automatically with a non-busy line lamp at a non-busy "A" position. The "A" operator responds by means of the corresponding listening key, whereupon the calling party announces the exchange name of the desired station. Associated with the listening key are locking keys in number sufficient to correspond to the number of different offices. The "A" operator depresses the desired one. This key locks and automatically initiates the selection of the calling line and its connection to a non-busy trunk to the desired exchange. The "B" operator responds and, ascertaining the desired number, connects the trunk to the proper multiple jack. If the line is busy a busy signal is sent back to the caller, and if not busy a ringing current is sent out to the called station. The "B" operator has supervisory signals both ways, and upon completion of a conversation she disconnects the trunk, thus automatically knocking down all circuits to normal and releasing the "A" keys.

LETTERS TO THE EDITOR.

Capacity of Condensers in Parallel.

To the Editor of Electrical World:

SIR:—The accompanying diagram shows an adjustable condenser, with plugs in two different positions, which invites attention to the fact that with unused plates it makes a difference whether or not the plugs are placed parallel.

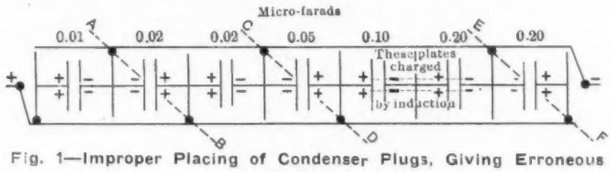


Fig. 1—Improper Placing of Condenser Plugs, Giving Erroneous Reading.

I recently made comparison with a standard 0.3-mf condenser which gave a throw on the galvanometer of eight divisions. Using the same battery and shunt I noted on the adjustable condenser that when the plugs were arranged as in Fig. 1, that is, parallel as per the dotted lines *AB, CD* and *EF,* the throw was ten divisions on the galvanometer, but with the lines of plugs not parallel, as in Fig. 2, the throw was eight and correct.

I varied all plugs, putting them in on the opposite sides, and

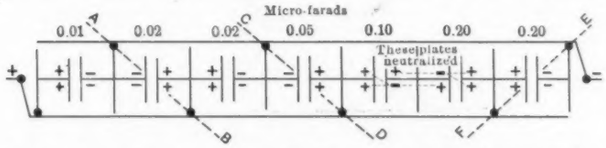


Fig. 2—Arrangement of Plugs So That Unused Condenser Plates Are Neutralized.

in each case when the plugs were parallel the reading would be ten, but when not parallel, as in Fig. 2, the reading was correct —that is, eight.

On the accompanying diagrams are shown the charges on the condenser plates of Figs. 1 and 2, which I believe sufficiently explains this variation.

It seems that when the plugs are parallel the unused plates are charged and used by induction. When the plugs are not parallel the induced charges on the unused plates are equal and in the opposite direction, which neutralizes those plates as it is intended should be done.

Valdez, Alaska. B. O. LENOIR.

Wattless Power.

To the Editor of Electrical World:

SIR:—I have read with much interest the communications of Messrs. C. O. Mailloux, John R. Carson and B. Spencer Greenfield appearing in your issues of Jan. 12 and 19.

With regard to wattless phenomena, I seem to have been accused by some of these writers of quarreling with the accepted mathematical methods of dealing with alternating-current phenomena, which are far more ingenious, accurate and conclusive than any that I could suggest. That is not the point of discussion, which is, briefly: What clear, concise and useful name shall we adopt to designate these phenomena in the various forms in which they appear?

Mr. Mailloux's second communication, to my mind, seems to suggest many valuable things. I am much pleased with the term reacting power, for it suggests in itself a power which is merely a quantity of energy transmitted back and forth between the generator and the receiver circuit and not appearing in its outside delivery. This power may be split into reactance power and condensance power or into inductance power and capacity power. These four adjectives go together in pairs; one should not be used without the other.

Referring to Ohm's law, I would say that it is impossible to discuss the e.m.fs. of an alternating-current circuit without arguing in a circle. They form a closed figure. It has been customary heretofore to open the circle or closed figure at the terminal e.m.f. and argue around the circle until the forces balance and to begin with what seems to me to be a very injurious statement that Ohm's law does not hold. If Ohm meant the terminal e.m.f. in framing his law this is certainly true; but there is no evidence except by inference that he did mean this. If, however, we open the closed diagram at the resultant e.m.f. and split it up into its components, attacking the problem analytically rather than synthetically, we can point out that Ohm's law does hold provided that the right E is selected. This E is definable in two ways, not in one; the first as IR and the second as the vector sum of the other e.m.fs. contained in the circuit.

I wish to take exception to the last paragraph of Mr. Carson's communication, in which he urges that Ohm describes the resistance of a circuit as a constant and seems to carry with this description the idea that the resistance of the circuit would be a constant, no matter what happened to it. It seems to me that to argue the fallacy of the law on account of change of the resistance due to rising temperature is quite as misleading as to argue the fallacy of the law in case the circuit was surreptitiously opened and more resistance inserted. The same reasoning, to my mind, holds good when high-frequency phenomena force the current to travel in certain parts of the circuit and to leave other parts of the circuit partially or fully out of commission, as is the case in the well-known skin effect.

Referring to gases and the conduction of electricity through them in highly attenuated confines, there is much evidence to show that the transference of electricity in such a case is by the convection of highly charged particles and not by conductance in its regularly understood form. As convection and conductance are two entirely different physical phenomena, it is not surprising that one law does not cover them both.

In undertaking a theoretical discussion it is always best to try to make laws, theories and formulas fit facts; and when a condition of affairs arises which can be explained only by a faulty premise it should be finally rejected. It is much better in discussing phenomena of this kind to show how fundamental laws work, rather than why they fail. To have a fundamental physical law work in one case and not in another is, to the writer's mind, very confusing and undesirable.

New York. GEORGE T. HANCHETT.

Voltage-Wave Distortion and Life of Incandescent Lamps.

To the Editor of Electrical World:

Sir:—Referring to Professor Kinsloe's letter in your issue of Jan. 19, I regret exceedingly that any of the statements in my letter in the issue of Jan. 12 should have been considered by him to be "misleading or incorrect."

When Professor Kinsloe's original communication was first read there appeared to be two main points in which his report was incorrect.

First, statements concerning the regulation that would be obtained on the circuit whose wave was distorted by means of a saturated reactance.

Second, the fact that he found considerably less candle-power with the same watts on the distorted wave.

With reference to the first point, that "no effect worth considering could have resulted from this cause," my statements were based on the results of tests made on an arrangement, as near as I could produce it, like that described in the original article. When the same degree of distortion that was shown by the wave in the report was reached, the variation of voltage in the distorted circuit was, as near as could be determined, twice that of the generator. When the generator voltage was raised or lowered by 1 volt the voltage on the lamps on the circuit, which included the saturated reactance, changed by 2 volts. The regulation is also affected by frequency changes.

The object in questioning the regulation of a circuit distorted in this way was to find out what sort of an arrangement was used which did not behave in this way to a greater or less degree. We still lack this information.

With reference to the second point, the tests made and confirmed by those which Dr. Sharp communicated seem pretty good evidence that any difference of watts per candle on the two waves is of a different order from and much smaller than that recorded in Professor Kinsloe's paper. As the evidence submitted to establish this point has not been questioned, perhaps it need not be referred to again.

With reference to the oscillogram accompanying my letter and the conclusions drawn from it, these have no real bearing on the points being discussed, except that this means was taken to justify the use of a wattmeter instead of a voltmeter for the electrical measurement on both circuits. I did not intend to "lead one to believe that there is *almost no change* in resistance or temperature of tungsten filaments during a voltage cycle," for we all know that there is such a change, and that this change of temperature is sufficient to produce a "flicker visible to the naked eye." Because of the great increase in luminescence that accompanies a small increase in temperature this well-known flicker effect is due to a *small cyclic change of temperature*, too small, as shown by the waves, to make the power-factor of the lamp differ from unity by an amount that may be detected by ordinary measuring instruments. I have not attempted to discuss the question as to whether or not wave distortion *appreciably* affects the life of metal-filament lamps. My purpose in writing was only to call attention to the fact that for reasons which have now been somewhat thoroughly discussed Professor Kinsloe's publications cannot be accepted as sufficient evidence to warrant the conclusions which he has drawn from them.

Schenectady, N. Y. L. T. Robinson.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Voltage Drop of Three-Phase Generators.—J. Sumec.—The author gives the voltage vector diagram of the synchronous machine and then bases on this an analytical method for calculating the voltage drop. The increase of the magnetic stray flux with the increasing load is taken into consideration. A numerical example is added and various special points are discussed.—*Elek. Zeit.*, Jan. 26.

Lamps and Lighting.

Illumination of Public Libraries.—J. D. Brown, L. S. Jast and J. Darch.—Three papers presented before the (British) Illuminating Engineering Society on the illumination of public libraries. Jast emphasizes that point lighting should be avoided wherever possible, but it is probably a necessary evil for the reading tables or desks in most public libraries. For this purpose he prefers on the whole the ordinary cone-shaped opal shade as deep as it is possible to get it, so that the reader seated at the table is unable in any ordinary position to see any part of the lamp itself. For lighting the narrow gangway between bookcases the best average results are achieved by lamps over the center of the gangway. In the Croydon library "linolite" lamps have been fitted on the cornices of the cases, so arranged that the lamp on one case illuminates the books on the opposite case. Darch recommends that for low ceilings the lamps should be placed as high as the proper illumination of the ceiling will admit, and the direct light kept from the eyes by means of opaque or semi-opaque screens, in which case the lamps should not be inclosed in obscured glass. The form of these screens will depend upon the circumstances, but Fig. 1 is a suggestion for an average case and may cover an arc lamp, a filament lamp, incandescent gas or a regenerative burner. Indirect lighting is also specially suited to low ceilings. For reading desks he thinks it is important that each reader should have a separate lamp and readers should be left to switch on and off their own lamps. Some notes are added on lighting of news-stands. There was an extended discussion on the subject. The subject is also discussed in a long editorial.—Lond. *Electrician*, Jan. 27.

Metallic-Filament Lamp.—A note on the Graetzin metallic-filament lamp. Tests made by the Reichsanstalt on nine lamps did not show a single breakage up to 4000 hours; some of the

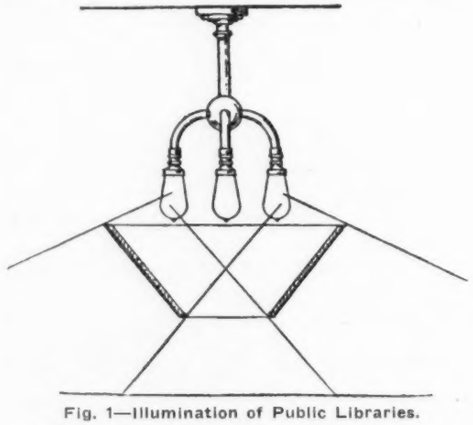


Fig. 1—Illumination of Public Libraries.

lamps are still burning at 6000 hours. The lamps tested were of about 26 cp at 115-117 volts direct current and had an initial specific consumption averaging 1.157 watts per mean hefner candle measured at right angles to the axis of the lamp. After 1000 hours the average candle-power was 23.54 and the consumption 1.27 watts per hefner and after 2500 hours the candle-power was still over 20, the consumption being 1.44 watts per hefner. Even after 4000 hours the candle-power averaged nearly 18 hefners. The special lines are the high-candle-power lamps of from 100 cp to 1000 cp for public lighting.—Lond. *Elec. Review*, Jan. 27.

British Metallic-Filament Lamp Works.—An illustrated description of the Brimsdown lamp factory in which the Kuzel colloidal process for making tungsten lamps is employed. Some details are given of the forming of the filament and the testing of the lamps. The present output is 2,500,000 lamps a year.—Lond. *Electrician,* Jan. 27.

Arc-Lamp Electrodes.—A note on a recent British patent (9076, Jan. 19, 1911) of Gebr. Siemens & Company. Electrodes for flame-arc lamps are of carbon impregnated with or having cores of a mixture of one or more oxides of cerium, lanthanum, didymium or zirconium, with oxides of calcium, strontium and barium. A compound of calcium oxide with cerium peroxide is a suitable substance, and the addition of fluorspar tends to prevent hissing of the arc.—Lond. *Elec. Eng'ing,* Jan. 26.

Generation, Transmission and Distribution.

Transmission System in Germany.—An article on the project of a transmission system in the district of Mittelfranken. For the present the City of Ansbach is supplied with electrical energy from a plant containing two Diesel engines of 335 hp and 540 hp coupled to 5000-volt, three-phase generators. A very large transmission system is, however, projected and contracts have been made with 1529 towns for energy supply. Either a water-power will be developed or a large steam plant will be built near Nuremberg. The latter seems to be more profitable since the first cost is much less and the generating plant would be at the center of gravity of the transmission system. It is expected that nine-tenths of the total energy would be sold to the cities of Nuremberg and Furth.—*Elek. Zeit.,* Jan. 26.

Energy Transmission.—W. T. TAYLOR.—A paper read before the (British) Institution of Electrical Engineers on modern long-distance transmission of electrical energy. The author, after a short introduction, deals with the general design of long-distance transmission systems worked at pressures up to 100,000 volts, poles, insulators, protective devices and switchgear receiving special mention.—Lond. *Electrician,* Jan. 27.

Electric Equipment of Docks.—W. DIXON AND G. H. BAXTER.—An illustrated paper read before the (British) Institution of Mechanical Engineers on modern electrical dock equipment with special reference to electrically operated coal hoists. The paper deals with the electrical equipment of the Rothesay dock on the Clyde. This installation has been carried out by the authors, and the results obtained show a great saving over hydraulic operation, while as regards reliability, etc., the electrical plant leaves nothing to be desired.—Lond. *Electrician,* Jan. 27.

Traction.

Railless Traction in Germany.—A note stating that two installations of railless traction have recently been provided in Bremen to connect the outlying districts with the ordinary tramway service in the city. The cars are similar to motor omnibuses in size, but they are much lighter and also possess advantages in being quieter while running and in not emitting any odor due to exhaust gases. The cost of construction is said to have been about one-fourth of that of ordinary tramways. The electric conductors, one for the positive and one for the negative, are placed about 8 in. apart, one above the other. The trolley consists of two rollers which travel on the upper wire and two hoops which are pressed against the lower one. In order to allow the car to deviate from a straight line and to pass other vehicles the wires connecting the car with the trolley are automatically uncoiled from a drum placed inside the car. This drum also takes up the spare wire immediately it becomes slack. For small deviations, up to 6 ft., a patent cable loop is provided. When one car meets another the conductors of the cars exchange trolleys.—Lond. *Electrician,* Jan. 27.

Catenary Suspension.—HENSIG.—An English translation of his recent German paper on the use of catenary suspension for street railways.—Lond. *Electrician,* Jan. 27.

Installations, Systems and Appliances.

Trouble in Two-Phase Networks.—A. T. BULLEN.—An illustrated article on a peculiar "two-phase complication" in a two-phase, four-wire system with 200 volts between the outer and inner wires. There is usually an earth of greater or less resistance on each outer, which does not vary to any great extent from time to time, but it is not entirely unknown for one outer to be only relatively slightly earthed on one day and dead-earthed the next. Some time ago there was connected to the circuit a 75-hp, two-phase motor, its consumption being measured by two single-phase meters with series transformers. The average monthly consumption was, roughly, 1000 kw-hours on each phase. For some cause the motor developed a serious fault and had to be partially rewound. The rewinding was intrusted to a local firm, and unfortunately resulted in the wires to the terminals becoming crossed inside the motor. The machine was reconnected to the mains, connecting the same leads as before to the same terminals so that as the net result one winding was connected across the two inners and the other across

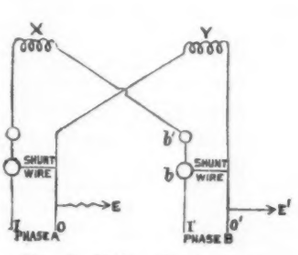


Fig. 2—Motor Connections.

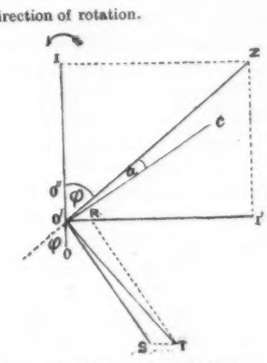


Fig. 3—Phase Connections.

the two outers, as indicated in Fig. 2. Owing to a peculiarity in the earths the motor started, although slowly. It continued to run under these conditions for a considerable period with a current, measured by an ammeter in one winding, about 20 per cent in excess of the current when correctly connected. The results as indicated by the company's meters were perplexing. One meter commenced to run backward at about one-quarter the speed of the other, or, to be more precise, the registration on one meter was 2400 per month as against 600 in the reverse direction on the other. The motor refused to start one day; then the wrong connections were discovered. The following explanation is given: X and Y represent the two windings of the motor; IO and $I'O'$ are the inners and outers of phases A and B respectively of the company's supply; a and b are the meters on phases A and B respectively, the series transformers being omitted for the sake of clearness; a' and b' are the ammeters on the same circuits. The motor connections are as shown. E and E' are partial and dead earths respectively on the outers of phase A and B. The difference of potential under these conditions across the inners is rather less than 283, and across the outer an unknown quantity, x, which was just sufficient to produce a dull glow on the 200-volt lamp tapped across. The phase angle between these two voltages is much less than the phase difference would have been had the motor been correctly connected, hence the poor starting torque (see Fig. 3). By vectors, $O'Z$ represents, in phase and magnitude, the voltage across the inners, less than 283, since $O'I$ is a voltage less than 200. OO', the voltage across the outers, has a phase difference from $O'Z$ represented by the angle ϕ. $O'R$ and $O'S$ are the fluxes created by these voltages, resulting in a rotating field represented in magnitude by $O'T$. It is now clear that, under the conditions defined above, motion will take place, the motor running in the correct direction. The alterations in conditions can only be explained by the partial earth becoming a dead earth and thus destroying all difference of potential between the outers of the two phases. Since no rotating field now results the motor refuses to start. A test on the outers after stoppage showed definitely two dead earths. Some suggestions are also made as to the reason why the two meters read differently. It is recommended that the terminals of motors should not be marked simply 1, 2, 3, 4, and that it would

simplify matters and prevent recurrences of mistakes if they could be marked A_1, A_2, B_1, B_2.—Lond. *Elec. Review*, Jan. 27.

Meters.—H. E. Goody.—The author emphasizes that the "readableness" of a meter is a very important property and that an attempt should be made at the standardization of electricity meter dials. In having to read a dozen types of dial inspectors are at a disadvantage compared with their gas-company confrères. Apart from the individual difficulties of particular meters, this extensive variety of dials greatly increases the liability of error. The author suggests the following tests: "Fix the meter in a perfectly dark cellar, 8 ft. from the ground. Stand on the ground 6 ft. away and strike a match; if the meter can be read under these conditions it may be considered to have passed the test. If the meter cannot be read or can be read only with great difficulty experiment with others until success is attained."—Lond. *Elec. Review*, Jan. 26.

Small Central Stations.—A. R. Garnier.—The first part of a long serial giving statistical data on economic conditions of establishing and running small central stations. He thinks this is a subject to which far more attention should be paid. The article is to be continued.—*L'Industrie Elec.*, Jan. 25.

Electric Cooking.—H. Gray.—A paper read before the Manchester Section of the (British) Institution of Electrical Engineers. The author gave results of tests to show that the cost of electric cooking with energy at 1.5 cents per kw-hour could work out cheaper than with gas at 62 cents per 1000 cu. ft.—Lond. *Elec. Eng'ing*, Jan. 26.

Electricity in Agriculture.—Krohne.—An article with reference to the recent French paper of P. Lecler presented before the International Congress at Marseilles giving data on the use of electricity for plowing and also for driving various other agricultural machines.—*Elek. Zeit.*, Jan. 26.

Wires, Wiring and Conduits.

Earthing of High-Tension Transmission Systems.—W. M. Dempster.—The author points out that certain of the advantages of earthing the neutral of low-tension three-wire direct-current and four-wire alternating-current systems do not appear to be realized on extra-high-tension systems. At present there exists a considerable diversity of opinion as to the relative merits of star and delta connections for extra-high-tension transmission networks. He refers to an incident in which a coal mine was connected not only by means of the regular line, but also by means of a stand-by line to the station, but on an accident to the former the latter also broke down at once when connection was made. This was a three-phase system and it was found that in both lines one phase had broken down; thus out of six wires there were four that were sound and by selective switching the faulty phases could have been ascertained. The author recommends employing a single spare wire to replace one that has broken down. For this purpose short lengths of flexible cables should be kept on hand. This might afford as great a security as a double line of six wires. The amount of insulation required by an earthed delta system would be very little more than that required by an earthed star system, the line voltages being the same, but a star system is liable to fail in six ways, whereas a delta system may fail in only three ways, and the number of ways in which a system can fail may be taken as some measure of its vulnerability.—Lond. *Elec. Review*, Jan. 27.

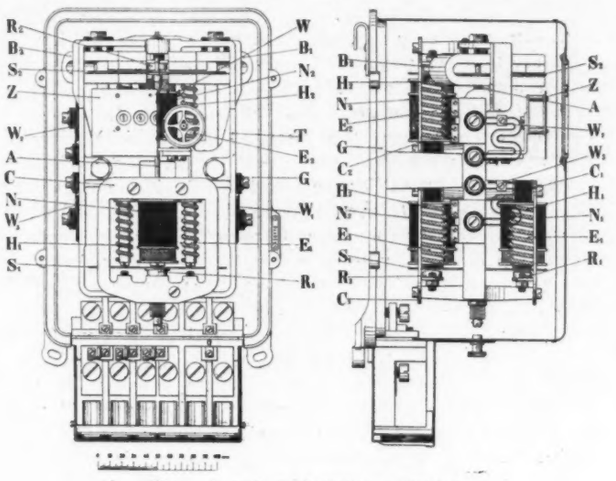
Overhead Lines.—L. Berland.—A long theoretical paper giving formulas and diagrams of the effect of temperature variations and wind pressure on overhead lines in order to enable one to calculate quickly a transmission line in such a way that even under the most unfavorable conditions of temperature and wind pressure the different coefficients of safety are within the limits permitted by the French law. If the coefficient of safety is 5 with a wind pressure of 120 kg per square meter it becomes 5.72 if the wind pressure becomes zero and the temperature remains at 10 deg. If the coefficient of safety is 5 with a wind pressure of 30 kg per square meter it becomes 5.08 if the wind pressure becomes zero and it becomes 10.88 if the temperature passes from —20 deg to +10 deg. C. The limits of the coefficients which satisfy the French regulations are, therefore, 5.172 and 10.88. It would, therefore, be necessary to allow a coefficient of safety of 10.88 when stretching the line at a temperature of +10 deg. C. and with zero wind pressure, whereby the coefficient of safety could never get below 5 under the conditions of temperature and wind pressure considered in the French law.—*L'Industrie Elec.*, Jan. 25.

Calculation of Transmission Lines.—W. Deutsch.—The conclusion of his mathematical article in which the author explains the method of Blondel and LeRoy for investigating the phenomena in long-distance high-tension lines with a practical example for the calculation of a cable.—*Elek. Zeit.*, Jan. 26.

Units, Measurements and Instruments.

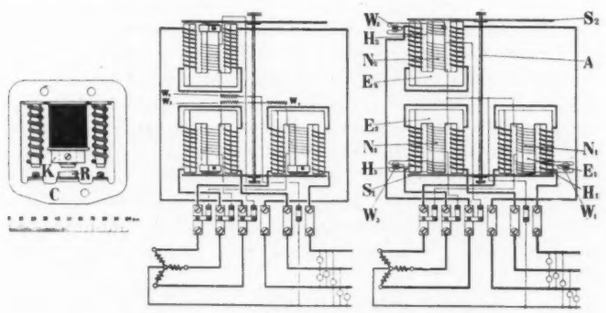
Electric Meters.—W. Lubach.—A review of recent progress in the manufacture of electric meters in Germany. A single factory is now making 600 meters per day and all the German meter factories are being re-enlarged and re-equipped. About one-half of the production is exported to other countries. In Germany itself the number of meters in use during the last ten years has increased 1000 per cent, and it is expected that within the next ten years it will again increase by the same percentage. According to statistical data of many years the life of an electricity meter is on the average about seven years. The main reason for the changes in meter manufacture is the greater use of metallic-filament lamps. While in installations with carbon lamps meters for from 10 amp to 50 amp were mostly used, a fairly good-sized installation, say, of eighty metallic-filament lamps, each of 25 cp, requires a meter of only 10 amp and 220 volts. Smaller installations require meters of from 1 amp to 5 amp, and there is a very large demand for such sizes. With the old types of meters the curious observation was made in smaller and medium-sized installations that the energy consumption of the meter itself was greater than the energy consumption of the consumer if the latter used only one or two of his metallic-filament lamps. The consumption of an older type of 220-voltmeter being about 6 watts, there was a consumption by the meter of 144 watt-hours in a day, while a metallic-filament lamp consuming 26 watts requires only about 125 watt-hours if used for five hours during the day. As a matter of fact, there are new lamps on the market which consume only 18 watts or 15 watts. The requirement is, however, made now that the consumption of the meter in the shunt circuit shall not be more than 1.5 watts at 110 volts. Stricter requirements are also made concerning the starting of the meter. A few years ago one was satisfied when a meter gave correct readings at one-tenth full-load and when it started at one-hundredth full-load; now correct readings are required at one-twentieth or one-fiftieth full-load and starting at one-two-hundredth full-load. With direct-current meters the difficulty of protecting them against external magnetic fields is also increased. With induction meters for single-phase and polyphase currents the stricter requirements can be more easily fulfilled. Measuring transformers have been perfected to such a degree that it is no longer necessary to calibrate the meters together with the transformers. By correctly proportioning the stray fluxes with respect to the active fluxes the effects of voltage variations in single-phase and polyphase meters have been brought to zero. Modern meters are also independent of the frequency. Less progress has naturally been made recently in the Thomson direct-current watt-hour meter based on the dynamometer principle, as it had been improved before to a large degree. Magnet motor-meters for direct current have found greater favor in the last years and have been improved in various respects. With respect to accuracy at low loads the electrolytic meter is most exact. Meters with mercury anodes were greatly improved by using a solution of mercury iodide and potassium iodide, and the formation of crystals in older types of meters has been overcome. However, this type of meter has not been sufficiently long in practical use, and the lack of a recording device is a disadvantage since it encourages fraud. In a few German works maximum-demand indicators and in a large number of works double-tariff meters are being used, while other plants have returned to the flat rate.—*Elek. Zeit.*, Jan. 26.

Induction Meter.—An official announcement of the Reichsanstalt on the construction and calibration of induction meters for four-wire and three-wire three-phase systems of the Siemens-Schuckert Company. The meter shown in Figs. 4 to 8 is for use with three-phase systems with a neutral wire, but can also be used in three-wire, three-phase systems. There are two armature disks S_1 and S_2 mounted on the same axle A and three groups of electromagnets, E_1, E_2, E_3, and two braking magnets,



Figs. 4 and 5—Induction Meters.

B_1 and B_2. The design of a single electromagnet group is shown in Fig. 6, which shows the three magnet cores of the iron piece. These three cores are screwed to the iron yoke ring C. The direction of rotation of the rotary field has no effect on the registration of the meter, so that the three outer wires can be exchanged at will when the meter is connected. An additional displacement of phase of the shunt field is produced by means of a solid copper ring K for meters for less than eighty alternations and the excess of this displacement beyond 90 deg. is annihilated by means of the three resistors of low resistance, w_1, w_2, w_3. For frequencies of 80 or more alternations no solid copper ring is used, but a small additional coil, its circuit being closed through a resistor of adjustable resistance W. The former arrangement is shown in Fig. 7, the latter in Fig. 8. The iron cylinder R, which is opposite to the central shunt pole of the electromagnet, is cut off so as to have an oblique surface for adjusting the starting. Two iron screws in the yoke ring, opposite to the two outer main-current poles, are used for regulating the torque. All the effective parts are mounted on the frame T. The two braking magnets B_1 and B_2 act on the front part of the upper armature disk. The two



Figs. 6, 7 and 8—Induction Meters.

armature disks S_1 and S_2 are made of sheet aluminum 1 mm (39 mils) thick and have a diameter of 115 mm (4½ in.).—*Elek. Zeit.*, Jan. 26.

Instruments.—The conclusion of the illustrated description of the recent annual exhibition of apparatus of the Physical Society in London. The description includes a potentiometer, a recording accelerometer working on the Wimperis principle and some precision instruments.—Lond. *Electrician*, Jan. 27.

Instruments.—H. PECHEAUX.—A brief description of various measuring instruments exhibited at the Brussels Exhibition in 1910, including the Duddell oscillograph, the Einthoven thread galvanometer, the Duddell hot-wire galvanometer for measuring high-frequency currents, etc.—*La Lumière Elec.*, Jan. 28.

Telegraphy, Telephony and Signals.

Telephone Cables.—The conclusion of the very extended discussion of the recent paper of W. A. J. O'Meara, D. Davies, of the Eastern Telegraph Company, said that experiments suggested by Sir Oliver Lodge were made in the laboratories of the Associated Telegraph Companies some time ago with the object of producing a distortionless cable. An artificial line of the ordinary type used in submarine telegraphy was made and into this they introduced inductances at regular intervals right along the line. These inductances were ironless and were variable. Leakages were also introduced at similar intervals, and these intervals were represented by about 3 mfd of the line. The interval corresponded with about ten nautical lengths of cable of mean thickness. The leakage could be varied in resistance from zero up to 1 megohm and the inductance could be varied from zero up to 1 henry. The conductor of the cable itself could also be varied, so that the arrangement was flexible. The cable became extremely lively when distortionless. Signals issued at the distant end very much of the same character as they were sent in. The signals needed little or no correction in the

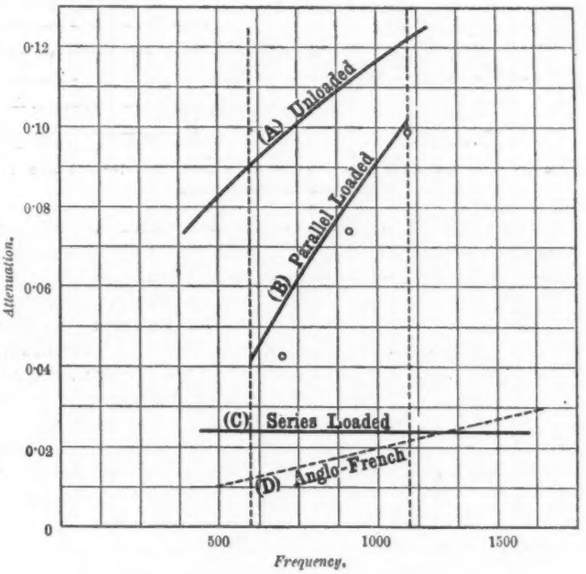


Fig. 9—Loaded Lines, Attenuation and Frequency.

way of shaping at the receiving end, and the line acted almost as an ordinary aerial line. From the distortionless point of view the experiment was a successful one, but, unfortunately, although the signals came out very crisp and sharp they were very attenuated. Results are also given of experiments with loaded cables without leakage. B. S. Cohen, of the National Telephone Company, had prepared figures relating to tests for drumminess which, he thought, formed an additional argument in favor of using light conductors loaded pretty heavily instead of heavy unloaded conductors. He also gave results of experiments that had been carried out with parallel loading according to the system of S. P. Thompson (as distinguished from the series system of Pupin). In Fig. 9 the upper curve A shows the variation of attenuation with frequency on an unloaded line consisting of 20.5 miles of 20-lb. conductor cable. The next curve, B, shows the variation when the same line was loaded on the Thompson method with a 0.2 henry coil placed across the line every five miles, giving a loading of 1 henry per mile. The spacing was in accordance with the Pupin spacing formula. It is seen that between the limits of 600 periods and 1100 periods, indicated by the dotted lines, the attenuation variation was greater than when the line was unloaded. The third curve, C,

shows ordinary series loading on the same line. The attenuation variation is practically negligible. The dotted curve was obtained by measurement on the Anglo-French cable. He would like to ask what was wrong with this measurement. There must have been a great deal of unloaded cable in circuit, and, therefore, the curve did not give the true attenuation variation for the loaded cable.—Lond. *Electrician*, Jan. 27.

Improvements of Telephones.—K. W. Wagner.—Progress in telephony will probably be based on further improvements in the Bell and Gray instrument. The author discusses various scientific points of the theory of the telephone. If an alternating current of the frequency n is passed into the receiver winding, the receiver winding has an impedance $r + j\,2\pi f L$, due to the combination of the effective ohmic resistance r and the effective self-inductance L. The values of r and L depend on the frequency and are also different when the diaphragm is in vibration or at rest. The author has determined experimentally the values of r and L as functions of the frequency $\omega = 2\pi f$. The results are given in Fig. 10 and show especially a very sharp maximum

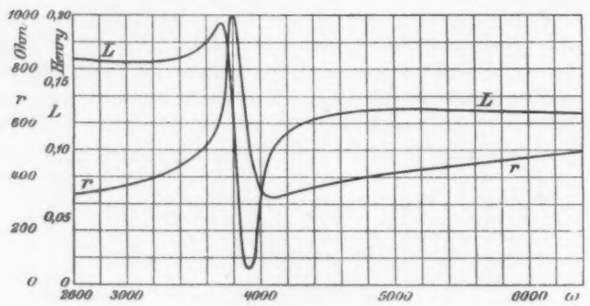


Fig. 10.—Telephone-Receiver Resistance and Self-Inductance for Conditions of Resonance.

of the curve r at the frequency of the fundamental wave of the diaphragm (condition of resonance). The question arises whether a receiver which behaves so differently for different wave-lengths is able to reproduce speech correctly. As a matter of fact, the receiver to which the illustration refers does so. The author concludes that the proportion of the amplitudes of the harmonic components does not solely determine the character of a sound. Breisig has found by experiment that for purposes of telephony the only important frequencies are between $2\pi f = 4000$ and 6000. Devaux-Charbonnel and Cohen and Shepherd have shown that frequencies below 4000 and above 7000 may be left out without any effect on the transmission of speech. To improve the receiver its sensitiveness must be increased, for instance, by a better utilization of its energy. This may be accomplished by an arrangement in which the mechanical forces of the magnetic field act in the most effective way on the diaphragm. For a circular diaphragm a circular flux is the best one. This is obtained when one pole-shoe is a cylinder and the second pole-shoe is a concentric hollow cylinder, the winding of the receiver being placed between the two. While others were not successful with such constructions, probably on account of defects in the design, Baehr has made such a receiver which is superior to ordinary receivers. He wanted to decrease the parasitic sounds in the receiver. To do this the higher harmonics of the diaphragm should have as small amplitudes as possible or the diaphragm should be tuned strictly to the fundamental wave. For this purpose the momentum of inertia should be concentrated in the center of the diaphragm. Baehr used diaphragms of mica, wood and brass with a circular piece of iron in the center. This arrangement is effective only with receivers with a circular symmetric magnetic flux. The author finally discusses the energy losses in the receiver, due to the heat produced in the circuit, eddy-current losses and hysteresis losses. The paper is to be concluded.—*Elek. Zeit.*, Jan. 26.

Telephone Condensers.—A note on a recent British patent (30,548, Jan. 19, 1911) of C. Cordes. Insulating substances of high dielectric capacity are produced from vegetable or animal oils, such as castor oil, by treatment with hydrogen in the presence of a finely divided metal, which acts as a catalyzer. Double the capacity for a condenser of given size is claimed as compared with paraffin condensers.—Lond. *Elec. Eng'ing*, Jan. 26.

Tenant's Right to Install Telephone.—In Germany a house owner had forbidden his tenant to get telephone connection, but the court decided that the house owner must permit his tenant to make the installation if he wants it.—*Bl. f. Post u. Tel.*, Vol. 6, 1910, page 299; *Elek. Zeit.*, Jan. 26.

Theory of Wireless Telegraphy.—H. Poincaré.—In an appendix to his highly theoretical paper on several problems relating to wireless telegraphy the author gives some mathematical proof necessary to demonstrate his former calculations. Among others, he demonstrates a theorem analagous to that of Green.—*La Lumière Elec.*, Jan. 28.

Wireless Telegraphy in Germany.—The (British) Marconi Company had made wireless installations on several German steamers of the North German Lloyd and the Hamburg-American Line, while the (German) Telefunken Company had made numerous installations on other German steamers. There has been sharp competition between the two companies, but they have now combined. The new company has taken over all existing installations.—*Elek. Zeit.*, Jan. 26.

Wireless Telephony.—A note on a recent British patent (1518, Jan. 19, 1911) of A. A. Jahnke and S. C. Tate. Their heavy-current transmitter for wireless telephony consists of two iridium-platinum electrodes inclosed in a chamber filled with carborundum granules. One electrode is attached to the main diaphragm. The annular wall of the chamber is of porous material, and alcohol or other volatilizable hydrocarbon is forced into the chamber through this wall. The evaporation of the alcohol cools the granules.—Lond. *Elec. Eng'ing*, Jan. 26.

Miscellaneous.

Electric Properties of Celluloid.—G. L. Addenbrooke.—Celluloid belongs to the class of what may be called abnormal insulators, of which water and alcohol are perhaps typical. In several ways celluloid would be an ideal insulator for many purposes if its properties could be brought into line with such materials as rubber and shellac, but at present this does not seem possible. Although as an insulator celluloid of ordinary quality ranks much below even gutta percha, nevertheless from a practical point of view its insulating properties are for many purposes quite respectable, and the writer has been much pleased lately with the properties of some of the copper wire covered with a celluloid varnish which is now coming in use. It would be consequently unwise to condemn it altogether for insulating purposes. The author gives some results of tests of his own and compares them with tests of Vallauri. The latter used "commercial black celluloid," while the author employed ordinary transparent celluloid. Hence there are some discrepancies in the results. Vallauri found a specific resistance of 8000 megohms per centimeter cubed, while the present author found 40,000 megohms per centimeter cubed. In such tests it is important to secure perfect contact with the conductors in making condensers and in testing the properties of insulators. When the dielectric is not liquid and cannot be melted into contact with the conducting plates there is only one method which will give approximately correct results for comparative purposes, and that is to test the material between two mercury faces under some pressure. To use any material with a solvent action which might contain any traces of moisture is almost certain to cause an alteration of the properties of the dielectric. Some notes are also given on capacity and power-factor.—Lond. *Electrician*, Jan. 27.

Ozone Ventilator.—An illustrated description of an ozone ventilator made by a German company in which the ozone is produced by the action of a Nernst filament. The whole apparatus is automatic and may be used either as a ventilator alone or as a ventilator and ozonizer together. The atmospheric oxygen is transformed into ozone in amount of not more than 0.1 per cent. Even with continuous operation no higher intensity is produced, since when the concentration tends to increase, the excess of ozone is at once decomposed. The power consumption of the ozone-ventilator is 85 watts. It is used on 200-volt and 230-volt direct-current circuits.—*Elek. Zeit.*, Jan. 26.

BOOK REVIEW.

INDUCTION COILS AND TRANSFORMERS. By H. Winfield Secor. New York: Modern Electric Publishing Company. 92 pages, 70 illus. Price, 25 cents.

Amateurs interested in the construction of induction coils and transformers for high-potential, high-frequency, X-ray, wireless-telegraph and wireless-telephone purposes will find in this pamphlet a number of useful suggestions for the design, proportioning and selection of material for induction apparatus. Tables giving coil dimensions, condenser sizes, sparking distances, dielectric constants and wire data applicable to the amateur's problems are included as an appendix to the descriptive matter. The book is one essentially for young amateurs, the treatment being of little or no value from the standpoint of design.

New Apparatus and Appliances

COMMERCIAL VEHICLE SHOW IN CHICAGO.

Several types of electric commercial vehicles were shown at the Commercial Vehicle Show in Chicago, given under the auspices of the National Association of Automobile Manufacturers, which came to an end on Feb. 11. The exhibition as a whole was an excellent one and was distinguished by its practical character, many of the vehicles being lettered with the signs of the business houses for which they were made. Gasoline trucks up to 10 tons and electric trucks up to 7 tons carrying capacity were shown.

The Anderson Electric Car Company, Detroit, had a delivery wagon, an express wagon and a chassis for any body. Edison batteries are used exclusively in these vehicles.

The Automobile Maintenance & Manufacturing Company, Chicago, showed two of its latest types of delivery wagons with disk wheels. This company gave a clever demonstration of the ingenious Walker balance drive which is employed on the cars of its manufacture.

The Baker Motor Vehicle Company, of Cleveland, had a 4000-lb. truck complete and a chassis for a 1000-lb. wagon.

The General Vehicle Company, of Long Island City, displayed a 3½-ton truck, a brand new 700-lb. delivery wagon and a 2000-lb. wagon. A feature of the exhibit was the silver cup won by this company in the Atlantic City reliability run of Aug. 12 and 13, 1910.

The Lansden Company, of Newark, N. J., had six vehicles on exhibition, mostly delivery wagons. One of these was an express wagon that has been in use for seven years in Washington. This car was driven from Washington to New York for the automobile show there over the country roads and is going back into regular service. It has a mileage record of 39,000 miles, averaging 295 working days a year. Another interesting feature of the exhibit was a 3-ton industrial truck designed for shifting goods at railroad stations, freight houses, steamship piers, etc. Another feature was an ambulance provided with solid tires and an elaborate arrangement of spiral springs to make riding easy.

Studebaker Brothers Manufacturing Company, of South Bend, Ind., displayed a 3-ton electric truck, a 5-ton and 7-ton chassis, a delivery wagon and a 1-ton baggage wagon.

Waverley Company, Indianapolis, displayed an ambulance which is especially interesting because it is equipped with an electric heater, electric water heater, a portable lamp and attachments for electrical instruments used for medical apparatus. This company also displayed a handsome electric hearse and a light delivery wagon.

Among the accessories of electrical interest shown were exhibits by Adams & Westlake Company, Chicago; American Ever-Ready Company, New York; Bosch Magneto Company, New York; Briggs Manufacturing Company, Elkhart, Ind.; Briggs & Stratton Company, Milwaukee; Connecticut Telephone & Electric Company, Meriden, Conn.; Edison Storage Battery Company, Orange, N. J.; Eisemann Magneto Company, New York; Electric Storage Battery Company, Philadelphia; Heinze Electric Company, Lowell, Mass.; Kokomo Electric Company, Kokomo, Ind.; Lutz-Lockwood Manufacturing Company, Aldene, N. J.; National Carbon Company, Cleveland; Pittsfield Spark Coil Company, Dalton, Mass.; Remy Electric Company, Anderson, Ind.; Simms Magneto Company, New York; C. F. Splitdorf, New York; United States Light & Heating Company, New York; Vesta Accumulator Company, Chicago; Willard Storage Battery Company, Cleveland.

AN ELECTRIC VEHICLE DINNER.

The third annual banquet given to electric vehicle manufacturers by the Electric Storage Battery Company, of Philadelphia, took place on Wednesday evening, Feb. 1, at the Mid-Day Club, Chicago, the following firms being represented: Automobile Maintenance & Manufacturing Company, Baker Motor Vehicle Company, Batten-Dayton Motor Company, Broc Electric Vehicle Company, Columbia Motor Car Company, Columbus Buggy Company, Dayton Electric Car Company, Hupp-Yeats Electric Car Company, Ideal Electric Company, C. P. Kimball & Company, Ohio Electric Car Company, Phipps-Grinnell Electric Auto Company, Rauch & Lang Carriage Company, Studebaker Automobile Company, Waverley Company and Woods Motor Vehicle Company.

Among the guests present prominent in the electric field were Messrs. Hayden Eames, Louis A. Ferguson, of the Commonwealth Edison Company; A. L. Salt, Western Electric Company, and C. E. Michel, of the Union Electric Light & Power Company. Mr. Herbert Lloyd, president of the Electric Storage Battery Company, and Mr. Godfrey H. Atkin, manager of the Chicago office, acted as hosts. At the conclusion of a vaudeville entertainment, which was given after the banquet, Mr. C. D. Firestone, president of the Columbus Buggy Company and representing the Columbus Buggy Company, in the name of the guests returned thanks to the Electric Storage Battery Company; to Mr. Herbert Lloyd, its president, and to the entire staff of the company located in every prominent business point in the United States, who, he stated, are ever ready to aid and care for every want of battery users.

EMERSON AND TROJAN ALTERNATING-CURRENT FANS.

The Emerson Electric Manufacturing Company, of St. Louis and New York, offers, as heretofore, a complete line of induction desk, oscillating and ceiling fans. This line includes 8-in., 12-in. and 16-in. swivel-trunnion desk fans, 8-in. hinge-type desk fans, 12-in. and 16-in. oscillating fans, special 12-in. slow-speed quiet residence-type swivel-trunnion and oscillating fans, two-blade, four-blade and six-blade ornamental-type ceiling fans and four-blade plain-type ceiling fans. The company reports improvements in several types of its fans for the season of 1911. The model shown in Fig. 1 is a three-speed 8-in. induc-

tion fan. It has the full swivel-trunnion adjustment, sliding lever switch, patented Parker blades, hardened-steel shaft and heavy double-wire guard of the larger sizes of Emerson fans and may be converted into a swivel-trunnion bracket fan. The 12-in. and 16-in. Emerson fans offered for general service are four-blade, two-speed fans of the same general appearance as the types illustrated. In addition a new residence type is offered this season. This is a three-speed induction fan

Fig. 1—Three-Speed Fan.

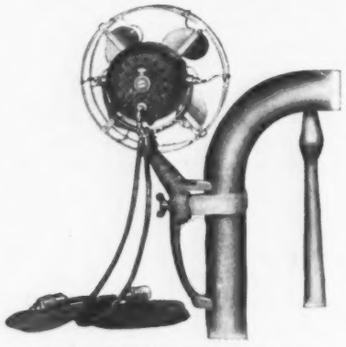


Fig. 2—Fan for Bedroom Use.

equipped with six Parker blades. It operates at a maximum speed of 1150 r.p.m. and the fan furnishes a well-distributed breeze for large living-rooms and operates with very little noise. The residence-type fan is also made in the oscillating style, in addition to which 12-in. and 16-in., medium-speed, four-blade oscillators, throwing more powerful breezes, can be furnished. All Emerson oscillators have a renewable oscillating worm shaft, so that all wearing parts of the oscillating mechanism can be renewed by the user. One of the novelties in fan motors offered by the company is the bedroom type shown above. This is an 8-in. Emerson trunnion fan mounted on a support which may be readily attached to the end post of the foot of any brass or iron bed. This fan is furnished complete with attachment plug and cord and push switch on an 8-ft. reinforced cord, so that the control of the fan is within easy reach of the user. The Emerson company also manufactures the Trojan line of swivel-trunnion desk and oscillating

Fig. 3—Residence Type of Fan.

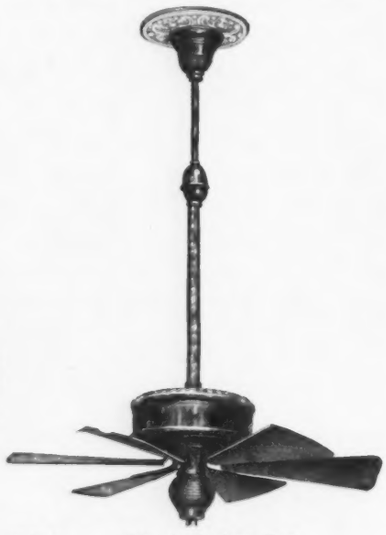


Fig. 4—Ceiling Fan.

fans in 12-in. and 16-in. sizes made in previous seasons. In addition a new 8-in. Trojan fan is offered this season, operated by a three-speed induction motor. It has triangular blades and bronze bearings; the motor is mounted in a drawn brass shell and base, and the motor body, base, fan blades and guard are attractively finished in brushed brass, satin finish. It is somewhat lighter in weight than the Emerson 8-in. induction fan. In ceiling fans the company makes a two-blade ornamental type for small offices, etc., where a gentle distribution of breeze is primarily desired, and a four-blade, two-speed plain type. A new type of Emerson induction ceiling fan is the three-speed, ornamental type, 32-in. sweep, six-blade fan shown herewith. This is designed to be hung in halls, doorways and entries. It is reported that small ceiling fans of this design have been extensively used in many sections of the country to keep out insects and that where the fan is used the screen door is often abandoned. This type of ceiling fan operates at a higher speed than the wide-sweep types and throws a stronger breeze directly under the fan, while not so well suited for general cooling purposes as the wide-sweep type.

CALIFORNIA GAS-ENGINE INSTALLATION WITH CRUDE-OIL PRODUCERS.

There is now in process of construction for the Holton Power Company, of El Centro, Cal., a gas-engine-driven generating plant which, it is believed, will greatly affect the means employed for producing power in those sections of the country where fuel oils are available and where water cannot be obtained in sufficient quantity for use in steam plants. The only satisfactory method of using this kind of oil successfully devised up to the present time has been the burning of it under boilers in which steam is generated for use in some type of prime mover. Within the past few years extensive experiments have been made on gas producers using this crude oil as a fuel, and these have now been worked out successfully, as is attested in their use by the government. The installation under construction will consist of a producer of this type and an Allis-Chalmers gas engine.

El Centro, where the plant of the Holton Power Company is to be located, is in the heart of what is claimed to be the richest agricultural section in the world, the Imperial Valley. Since the great irrigation project for this section has been completed numerous small communities have sprung up and towns have been established, to supply which the Holton Power Company has constructed a hydraulic plant at Holtville and a steam-auxiliary plant at El Centro. The present gas-engine plant is an addition which will take care of the rapidly growing business of the company. The towns served are El Centro, Calexico, Mexicala, Brawley and Imperial. Street and house-lighting circuits, motors for ice plants, cold-storage plants, brick manufacturers, cotton gins, pumping stations and other industrial purposes are supplied.

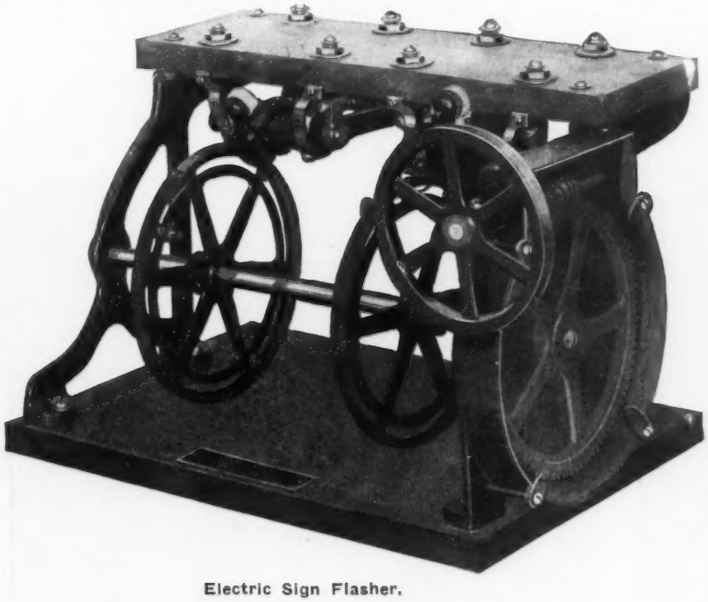
The new plant will be housed in an addition to the existing steam plant and will consist of three Ensign Amet oil-gas producers, furnished by the International Amet Producer Company, and an Allis-Chalmers 1000-hp, twin-tandem gas engine direct-connected to an alternating-current generator. All auxiliaries will be driven by Allis-Chalmers motors. With this installation electricity can be generated with a very great saving over present methods. Oil will be stored in a concrete tank from which it will be piped to the producers. In the producer a small amount of the oil is burned while the rest is vaporized and broken up into a fixed power gas suitable for use in the gas engine. The gas as it leaves the producer is exceptionally clean, having been scrubbed and freed of all impurities. It is, therefore, ready for immediate use in the engine or it can be stored in the holder ready for future use in case the plant serves as an emergency unit. From the producer the gas goes to the engine, which is provided with an air-starting device of sufficient capacity to put the engine into active service almost instantly. Cylinders, exhaust valves, pistons, piston rods and all parts coming in contact with the hot gases of explosion are water-cooled. The inlet valves are of the stratification type, which allows the separate control of both the gas and air, thus the mixture can be properly proportioned to meet the load. These valves are automatically operated and controlled by a centrifugal governor, belt-driven from the main shaft. The engine is direct-connected to a three-phase, 60-

cycle, 2400-volt, 150-r.p.m. alternator. Very close electrical regulation is provided by a 15-ft. flywheel weighing approximately 40,000 lb. This will make it possible to operate the gas-engine unit in parallel with both the hydroelectric plant and the steam plant. A complete gravity oiling system will be installed, which will make hand oiling unnecessary and will automatically keep all parts lubricated as long as there is oil in the main tank.

Operating with a much higher efficiency than can be secured when the oil is used as fuel under a boiler the installation will mean a great saving in the first cost of fuel. In addition there will be a great saving in the supply of water necessary. The only water needed for this installation is that used in the producer for the washing and that used in cooling the engine. While the amount used for cooling the engine is comparatively large it can be used over and over again, as the only loss is through evaporation in the cooling tower. The initial temperature of the cooling water is very high, being 95 deg., while it will leave the engine at approximately 145 deg. In order to save this water for further use a cooling tower will be built which will reduce the temperature to normal.

ELECTRIC SIGN FLASHER.

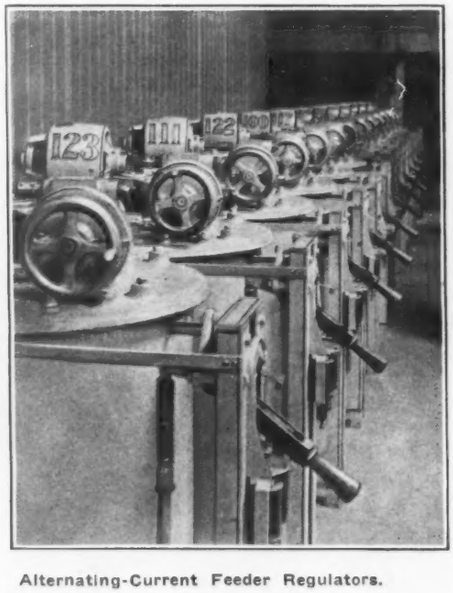
The Reynolds Electric Flasher Manufacturing Company, Chicago, Ill., has recently placed on the market a new line of single-pole, double-pole and triple-pole, quick-break knife-switch flashers which are claimed to be simple in construction, free from troublesome parts and to require little attention. The switches, which are made from pure copper, engage in bronze jaws made with the well-known Reco patent grease reservoir, a safeguard against burning, the grease dissipating the heat and reducing the arc to a minimum as well as continually lubricating the switch blade, insuring long life. The switches are opened and closed by a purely mechanical method. Switch blades and jaws are quickly and easily renewed by the removal of one or two screws. An improvement is the adjustable feature by which long or short, quick, or slow flashers may be regulated to suit any requirement. Switch wheels are provided with slots supporting the rollers which throw the switches in and out, and by moving the rollers back or forward adjustments are quickly and easily made, an ordinary screwdriver being the only tool necessary. The gearing is inclosed and runs in oil, giving a dustproof, self-lubricating and non-wearing drive.



Electric Sign Flasher.

ALTERNATING-CURRENT FEEDER REGULATORS.

Where an alternating-current central station is in competition with a direct-current plant in a large city conditions are very often unfavorable to the alternating-current proposition. The chief disadvantage arises from the sensitiveness of the voltage regulation to any changes in load. Where a large part of the load is made up of elevators or other machinery requiring frequent starting an alternating-current line is apt to suffer considerably more from fluctuations in voltage than is an equivalent direct-current line. The direct-current system suffers only from line drop, while the alternating-current line has the line drop of resistance and reactance and in addition an actual reduction of voltage at the generators or transformers due to the wattless current at the low power-factor of starting. A load that would produce a fluctuation in a direct-current line of 2 per cent or 3 per cent might, under some conditions, cause as much as 20 per cent fluctuation in an alternating-current line. In such cases the use of feeder regulators removes entirely this disadvantage of the alternating-current system and in many cases gives even better regulation than is obtained with a direct-current system. A case in point is that of the United Electric Light & Power Company, of New York. The 146th Street substation of this company supplies a load made up largely of apartment-house equipments, consisting mostly of lamps and elevator motors. The voltage fluctuation on the feeders due to the starting of elevators puts such a heavy drawback on the service as to make competition with the direct-current systems in the city, equipped with storage batteries and other equalizing devices, almost impossible. Equipping the system with feeder regulators, however, has not only resulted in marked benefits but has, it is claimed, made the service preferable to that of the direct-current system. The regulator equipment consists of twenty two-phase automatic induction-type feeder regulators, manufactured by the Westinghouse Electric & Manufacturing Company, Pittsburgh. Each regulator is of 85-kva rating and has a range of regulation of 10 per cent above or below the busbar voltage. Each regulator is operated by a 220-volt, 4/10-hp Westinghouse direct-current motor controlled by regulating relays. The relays operate through voltmeter compensators so as to maintain constant voltage at the service end of the feeders. Each feeder has a complete equipment of compensator, relays and regulators. The results obtained are in some ways remarkable. So sensitive are the relays that the voltage at the service point at no time varies more than 1 per cent. The automatic operation is practically instantaneous, and lamps, even in the same building with the elevator that is started, barely show a flicker. The voltage at the station end



Alternating-Current Feeder Regulators.

of the feeder, however, varies as much as 15 per cent, showing the part played by the regulators in smoothing out the voltage curve. The accompanying illustration shows a photograph of fourteen of these regulators in operation. The regulation depends on the angular position of a rotatable secondary core and winding relative to a stationary primary core and winding. the two windings being connected in series. Rotation of the secondary is produced by the small motor at the top of each case, controlled by the relays. The adjustment of voltage is gradual, which corresponds to practically an infinite number of steps. Each regulator is self-contained and cooled by air blast, with which the station is amply supplied for cooling its transformers.

ELECTRIC DRIVE IN A CEREAL MILL.

The sanitary preparation of pure-food products is best accomplished by using machines driven by electric motors, as this eliminates the use of the long lines of overhead shafting with their multitude of belts, pulleys, etc., which are characteristic of the mechanical drive and which tend to keep dust in circulation in addition to rendering a well-lighted factory an impossibility. Moreover, oil drips from the overhead shafting and limits the location of the machinery to spots free from this trouble. In addition the electric drive presents the highest degree of flexibility. In view of these advantages the Postum Cereal Company adopted the electric motor drive as the only one adapted to the production of the high class of food products it produces. This article deals only with the production of "Post Toasties," although the company also manufactures "Grapenuts" and "Postum," and employs the electric drive in their preparation. "Post Toasties" are made from corn grits, and from the time the latter leave the cleaning-room until the finished product, in the form of flakes, is sealed in cartons the entire process is handled by machinery exclusively, every precaution being taken to insure that the product shall be prepared under strictly sanitary conditions and be entirely free from dust or foreign substances. After undergoing a thorough cleaning process, the corn grits are cooked in rotary steam cookers, each of which handles 1500 lb. of the grits per batch. A 10-hp, 440-volt, three-phase motor drives six of these large retorts and is in continuous operation twenty-four hours a day for six days of the week, and at times it is necessary to run it seven days a week during rush periods. The group drive is employed, as the occasion never arises when it is desirable to run only a part of the cookers. As the service is not severe and the rugged induction motor is well adapted for continuous service it is not probable that it will ever cause an interruption of service. From the cookers the grits are carried by conveyors to a drying and curing process which puts the grain in condition for the flaking rolls, where the grits are rolled into thin flakes. There are forty-two of these and each roll is driven by a 35-hp, 440-volt, three-phase induction motor by means of a Reynolds silent chain. The load is a heavy and continuous one, and has frequently been tested, showing at times as high as 40 hp on each motor. The crushing of the hard grain into flakes is the source of considerable vibration, which is, to a certain degree, transmitted to the motors without apparently causing any trouble. These motors are also operated twenty-four hours a day. The flakes pass from the rolls through the ovens, where they are toasted. They are then conveyed to the packing-room, where a 10-hp squirrel-cage induction motor drives the conveyors and automatic packing machinery. The load here is very irregular and the motor operates eighteen hours a day. The finished product is delivered to this room by conveyors, and automatic machines then fill the cartons with it and seal them up ready for shipment. Fig. 2 shows four 7½-hp induction motors driving large ventilating exhaust fans used in connection with steam-radiator and drying apparatus. These motors also are in operation twenty-four hours a day. All the motors have given excellent service and have caused little or no trouble during the five years they have been in operation. The cost of maintenance has been practically nothing and there is no dead load to carry as in a plant which has the mechanical drive with its long main shaft, its counter-shafts, idlers, loose pulleys, etc. Two 150-kw and one 200-kw three-phase generator are installed in the engine-room of the factory, and, in addition, electrical energy at a potential of 4600 volts is purchased from the Commonwealth Power Company, Jackson, Mich., and stepped down to 440 volts for use throughout the factory by four 500-kw transformers. The electrical equipment throughout was built by the General Electric Company.

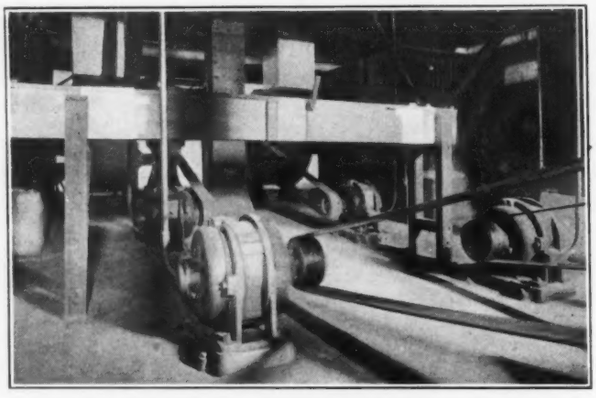


Fig. 2—Induction Motors Driving Ventilating Exhaust Fans for Drying Apparatus.

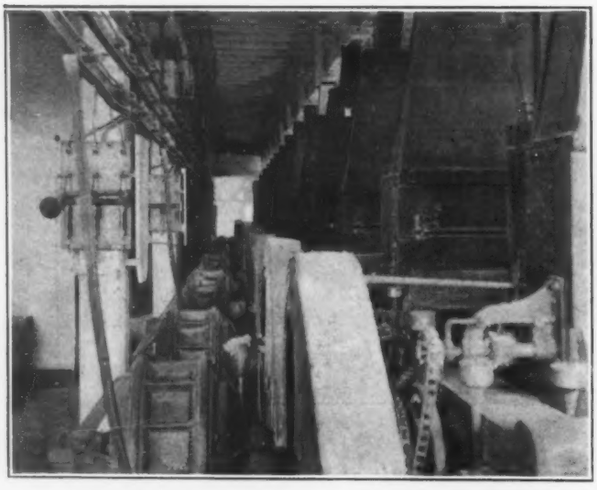


Fig. 1—Induction Motors Driving Flake Rolls.

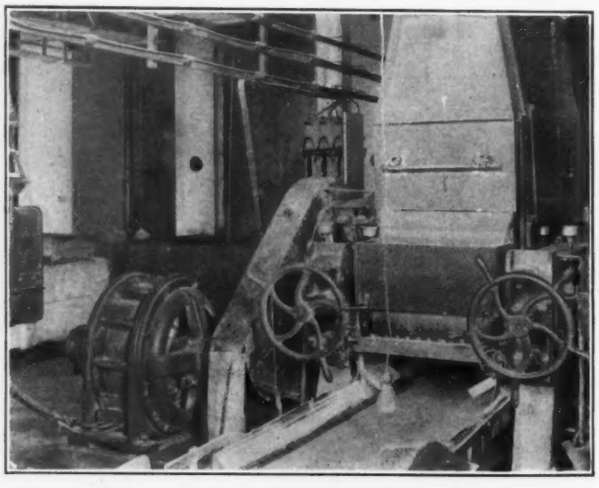


Fig. 3—Induction Motor Driving a Flake Roll.

Industrial and Commercial News

THE WEEK IN TRADE.

COMMERCIAL business continues quiet with considerable irregularity according to the different sections and different lines. As a rule the West and South show greater activity than any other sections. During the past week there continued to be a very healthy demand for agricultural implements, fertilizers and other products required by farmers. There was also, owing to weather conditions, a very large trade in rubber footwear. Wholesalers and jobbers report that orders are increasing but that there is yet apparent a spirit of conservatism which leads country merchants as a rule to buy only for immediate needs. The textile industry is still considerably disturbed and there is no evidence that cotton mills expect to increase output in the near future. In the iron and steel industry there is a much better feeling. Orders came in more rapidly in the last two weeks than at any time within the past three months and steel manufacturers as a rule are of the opinion that the low point has been passed. While there were no large rail orders during the week, quite a number of small sales were made and the demand for structural material was notably improved. In the building trades lumber and other building materials are still quiet. Official reports show in 110 cities increases in building projects over the same period last year. Chicago reports that $120,000,000 of buildings are planned for 1911 in that city. It is almost too early as yet to make any definite estimate of the great basic industry of the country—agriculture. Only a few reports as to the season's crops have been received but the outlook is generally pronounced hopeful. The heavy snows of the past week throughout the Northwest and the wheat-growing sections are taken as indicative of large crops. It is predicted that the acreage of both wheat and cotton during the coming year will be considerably larger than in 1910. Collections continue to be only fair, but business troubles are not particularly numerous. Business failures for the week which ended Feb. 9, as reported by *Bradstreet's*, were 291, against 290 the previous week, 249 in the same week in 1910, 211 in 1909, 326 in 1908 and 204 in 1907.

THE COPPER MARKET.

ACCORDING to the regular statement of the Copper Producers' Association for the month of January, which was the feature of the market last week, there was an increase in surplus stocks during the month of 20,409,295 lb., the total at the end of the month being 142,439,490 lb. This is to be compared with 98,463,239 lb. a year ago. Of the increase for the month more than 12,000,000 lb. is apparently due to steps that were taken to correct the discrepancies in the export reports made in 1910. It has been the custom of the association to report copper on lighters and ready for shipment as exports, while the United States government reports only give the copper actually cleared. This always created wide differences in the two reports, and the association has now taken steps to bring its figures into closer accord with the official reports. The general figures given out by the association for January were: Production, 115,696,591 lb., a decrease of more than 8,000,000 lb.; foreign deliveries, 53,208,739 lb., a decrease of 35,000,000 lb.; domestic deliveries, 42,078,557 lb., which is about the same as during the previous month, and total stocks, 142,439,490 lb. The interesting features of the report were that production was reduced and that sales were decreased. The low prices which have prevailed for copper for the past few weeks have brought out many small orders for finished materials and there has been especial activity shown in wire and cable since the beginning of the current month. It is estimated that recent sales for this class of material have aggregated between 10,000,000 lb. and 15,000,000 lb. and that they are directly traceable to price concessions made by manufacturers. Most of these sales have been directly covered by the purchase of new electrolytic copper or by the exercise of options which had been placed some months ago. Electrolytic copper during the past week sold from 12¼ cents to 12⅜ cents for cash and 12.40 @12.45 thirty days. Exports for February, including Feb. 10, have been 8185 tons. The daily call on the Metal Exchange Feb. 11 quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.87½	12.12½	.....
February	11.87½	12.12½	12.00
March	11.87½	12.12½	12.00
April	11.87½	12.12½	12.00
May	11.87½	12.12½	12.00

The London market Feb. 10 was as follows:

	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	54	15	0	55	0	0
Standard copper, futures	55	8	9	15	15	0

Extreme fluctuations for this year:

	Highest.			Lowest		
Standard	12.30c			11.87½c		
London, spot	£56	15	0	£53	15	0
London, futures	57	12	6	54	10	0
Best selected	60	5	0	58	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Ruling on Mica Duties.—The new Customs Court of Appeals has handed down a decision affirming the decision of the Board of General Appraisers in a case involving the duty on cut or trimmed mica. This case was brought in the name of J. W. Myers & Company, customs brokers, and involved mica imported at the port of Plattsburgh, N. Y., and at Albany. Speaking of the decision, Lewis W. Kingsley, president of the Mica Insulator Company, said: "The present decision of the Customs Court entirely sustains the position of the mica importers. According to the Payne-Aldrich tariff law unmanufactured mica pays duty at the rate of 5 cents per pound and 20 per cent ad valorem, while manufactured mica pays duty at the rate of 10 cents per pound and 20 per cent ad valorem. The mica in controversy was that which had had its edges trimmed with a knife. The appraisers held that this was manufactured mica, and imposed a duty at the higher rate. We appealed from this decision to the United States Board of General Appraisers, which board reversed the appraiser and decided that knife-trimmed mica was not manufactured. The government then appealed to the Customs Court, and the present decision practically settles the question by affirming the decision of the Board of General Appraisers. This permits knife-trimmed mica to come in at the lower rate of duty. It will be to the advantage of all electrical manufacturers, as it materially cheapens the product. There continues to be an excellent demand for mica, although there is no boom of particularly heavy business in sight."

Stave Long-Burning Lamp.—Theodore Stave, of the Stave Electric Company, New York, has recently returned from Germany, where he secured the American rights for the Tito Livio Carbone long-burning flame-arc lamp, which burns 150 hours or more on a single trim. The carbons are 10 in. long by ⅝ in. in diameter, and impregnated with luminous salts. Both the lamps and carbons are manufactured in Germany by the Allgemeine Elektricitäts Gesellschaft, and have been adopted for street lighting in Potsdam, Frankfort and in some portions of Berlin. In France a number of railroad corporations have also adopted them, the Gare de Lyons, in Paris, being illuminated with these lamps. Contracts for street lighting in Paris with the same lamps are now being drawn. Mr. Stave says that already he has had quite a number of orders for these long-burning lamps, and that inquiries are numerous. He has recently sold to the Alden-Sampson Company, of Detroit, thirty of the lamps; to the Syracuse Malleable Iron Company, sixty, and to James Leffel, Springfield, Ohio, thirty-eight. He expects to establish a factory in this country within a short time for their manufacture.

Union Switch & Signal Company.—The annual report of the Union Switch & Signal Company for the year 1910 showed a net profit of $1,250,000. It is said that the net earnings for January largely exceeded those of the corresponding month last year. New orders are being received in greater quantities than was anticipated at the present time, as it is generally the rule that the winter months are very dull. The present outlook, based upon January business, indicates that the company's gross and net earnings in 1911 will be largely in excess of those in 1910, which was the best year's business the company ever had. The improvements in the processes of manufacture will permit of the production of double the output of 1910, and the factory cost is being constantly decreased.

General Electric Sales.—It is given out that the new orders booked by the General Electric Company during the month of January were about 85 per cent of the orders booked during the same month in 1910. This means a business at the rate of about $58,000,000 per year. It is well known, however, that the first month of a company's new fiscal year is invariably below the average. Big manufacturing concerns endeavor to crowd into the closing month of their fiscal year all the business possible to swell the annual total. January's total was almost $1,000,000 less than the average monthly rate of 1910. The General Electric officials declare that they will be very well satisfied if the volume of business in 1911 is as large as it was last year. It is stated that manufacturing profits during 1910 were larger than for several years past. The company is steadily gaining in economy of production. During last year the manufacturing profit was close to 15 per cent, which is to be compared with less than 9 per cent in 1909. New construction work in 1911 will be relatively small; in fact, very little will be done beyond completion of the foundries and pattern shops already under way at Erie, Pa. The company has at the present time a capacity fully 30 per cent greater than its actual requirements.

New Haven Railroad Electrification.—The New York, New Haven & Hartford Railroad Company has declined $50,000,000 of additional money on the same basis at which it recently sold $22,000,000 of 4½ per cent notes. The company claims that at the present time it needs no additional capital. It is expected that the Hoosac tunnel electrification, which was the first work undertaken by President Mellen after he took charge of the Boston & Maine Railroad, will be finished early next month. This will double the capacity of the tunnel, and enable the Fitchburg Railroad to send through 2000 cars a day instead of 1000. The Massachusetts State Railroad Commission has reported against the electrification of steam roads in and around Boston, because it involved an expenditure of $40,000,000, but it is said that the New Haven road stands ready to invest $25,000,000 in such a project. The New Haven's plans call for the electrification of the Boston and Harbor tunnels and a four-track Salem tunnel, so that trains may be run electrically from Readville on the south to Beverly on the north.

Westinghouse Power Sales.—Among the recent power equipment sales made by the Westinghouse Electric & Manufacturing Company are apparatus to equip the power plant of the Standard Oil Company's refinery at Bayonne. This equipment includes four 225-kw generators with transformers, switchboards and other apparatus. A large number of individual motors were also sold to the same company. The plant will be gas-engine-driven. The same company has also sold to the Bethany Worsted Mills, of Passaic, N. J., one 1200-kw turbo-generator set. Sales of small motors for factory purposes within the past few weeks have aggregated between 5000 hp and 6000 hp. Reports from the general offices of the company indicate that since the first of the year the business has been very gratifying and it is believed that by the end of the company's fiscal year, March 31, the net earnings will show nearly 16 per cent for the assenting stock. The shipments in January from all plants amounted to about $3,000,000, which is 25 per cent greater than for the same month in 1910.

Swiss Magneto Company.—It was announced in Chicago last week that several men prominent in business and financial circles in that city and the East had purchased outright the patent rights of the Swiss Magneto Company. Among those interested are Joseph Ratzer, New York City; H. P. Smith and F. J. Wende, Chicago; B. B. Clarke, Madison, Wis., and M. B. Harxhurst, Waukegan, Ill. The consideration involved is said to be $100,000. This company has been manufacturing in its Chicago factory for about a year the ignition device known as the Swiss, and while for some time past entirely under control of American interests, the latter have been paying rather heavy royalties to the foreigners. This new arrangement removes the last vestige of foreign financial interest in the company. The management has contracted with the inventor for his services for a period of ten years and will also retain the various foreign engineers who have been associated with him. The Swiss is a high-tension magneto.

Westinghouse Export Orders.—Rockhill & Victor, of Shanghai, China, have ordered from the Westinghouse Electric & Manufacturing Company a 150-hp induction motor and water rheostat, to be used in operating a flour mill. Through Showan, Thomas & Company, of Pekin, the Chinese government has purchased two Westinghouse 150-kw direct-current generators and nine-panel switchboard for use in the Bureau of Engraving. The Salvador Madera Cia, San Luis, Mexico, has ordered a 160-kw direct-current generator, and the San Juan Light & Transit Company, of Porto Rico, has placed an order for Westinghouse apparatus, including seven 30-kw, single-phase, 60-cycle, 1100/110-320-volt transformers; five 25-kw, single-phase, 60-cycle, 1100/110-220-volt transformers, and a total of 230 hp in back-geared motors for a machine shop.

Lighting in Detroit.—The public lighting commission of Detroit has completed estimates of the funds that will be needed the coming year for extensions and improvements of the system. The total amount to be submitted to the controller is $526,436, but credits for the sale of old material and bills due for lighting service bring this down to $510,836, which is $89,126 above the amount granted last year and $13,000 less than was asked for the year before. Estimates show that the cost of maintaining arc lamps this year is $30, a reduction of $1.75 from last year and $15 from ten years ago. The saving is accredited to the use of modern apparatus and the commission is of the opinion that it can be reduced to $25 a year.

More Brooklyn Edison Equipment.—The Edison Electric Illuminating Company of Brooklyn has ordered from the General Electric Company the following equipment: One 12,000-kw turbine; two 1000-kw frequency changers; two 1500-amp boosters and four 45-kw balancers. In addition to this, switchboards and a large quantity of smaller apparatus were ordered. These purchases practically complete the Brooklyn Edison's requirements for power house additions during 1911. About an equal amount of equipment was ordered two weeks ago from the Westinghouse Electric & Manufacturing Company, which order was detailed in our issue of Jan. 26.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Lexington, Ky.; Dixie, Idaho; Snyder, Okla.; Polsen, Mont.; Westport, Conn.; Boston, Mass.; Dothan, Ala.; Great Falls, Mont.; Hope, Idaho; London, Ont., Can.; Phoenix Mills, N. Y.; Sandusky, Ohio; Helena, Ark.; New Iberia, La.; Wilmington, N. C.; Lansing, Mich.; Hiram, Ohio; Prineville, Ore.; Edmonton, Alta., Can.; Pittsburg, Kan.; Vancouver, B. C., Can.; Gilmore, Idaho; Pierce City, Idaho, and Coraopolis, Pa.

California Power & Manufacturing Company.—Articles of incorporation have been filed in California for the California Power & Manufacturing Company, with a capital stock of $5,000,000. The project is being promoted by F. G. Baum, of San Francisco. It is announced that the company will operate in the upper part of northern California. At the present time the promoter is not prepared to give the location of the hydroelectric development of his project. It is stated, however, that the organization is in nowise connected with the San Francisco power station.

Alabama Traction Company.—Work is being rapidly pushed forward on the lines of the Alabama Traction Company in Montgomery. This is the company that obtained a franchise from the City of Montgomery last Fall and proposes to run a line in opposition to the Montgomery Traction Company. About seven miles of track will be laid at the present time and the ties and rails are already on the ground. The present plan is to operate this road with storage-battery cars, though as yet no contracts for these cars or their equipment have been let.

American Manufacturers' Export Association.—Henry T. Wills has been appointed secretary of the American Manufacturers' Export Association. Mr. Wills is an expert in export trade matters, and has been secretary of the National Tariff Commission Association. Among the large manufacturing companies having membership in the association are the General Electric and Westinghouse companies.

Alberger Condenser Company.—George Q. Palmer, formerly vice-president, has been made president of the Alberger Condenser Company and the Alberger Pump Company. Mr. Palmer is succeeded as vice-president in the Alberger Condenser Company by D. H. Chester, and in the Alberger Pump Company by W. S. Doran.

Los Angeles Electric Railway.—Paul Shoup, manager of electric properties for the Southern Pacific Railway Company, is preparing plans for the construction of a tunnel in Los Angeles for the Los Angeles Electric Railway from Hill Street westerly. The rights-of-way for this project have already been secured.

Financial.

THE WEEK IN WALL STREET.

SALES of stock in Wall Street were somewhat reduced last week and business was very much less enthusiastic in tone. Prices remained fairly steady and the net changes for the week showed advances in about as many instances as recessions. In no instance was there any considerable change in an active issue. It seemed that the stock market was simply indulging in one of those pauses for breath-taking which very frequently occur after pronounced movement in either direction. These periods are regarded by traders of long experience as furnishing a better index to the actual strength or weakness of the market than does an excited buying or selling movement. If after a period of buying and an upward movement the market holds its position with fair strength it is generally thought that the advance was substantial and not purely speculative. Of course at the present time it is not to be expected that there will be any definite long swing in either direction. Professional and outsider are waiting for the decisions in the trust and rate cases. For this reason it is not at all surprising that the recent movement which began Dec. 6 and lasted until a week ago was one in which the outside public took absolutely no part. It was thought when the advance commenced that the market had been thoroughly oversold and was well liquidated. It is now the impression that there is a fairly heavy short interest in many of the active issues. It is not likely that there will be any definite movement in either direction until after the decisions above referred to have been rendered. The financial world is not willing to take an advanced position until its basis of operations has been settled. The money markets both at home and abroad have remained extremely easy and the bond market continues to be very satisfactory. Rates for money Feb. 11 were: Call, 2@2¼ per cent; 90 days, 3 per cent. The quotations in the table are those of the close Feb. 11.

NEW YORK.

	Feb. 6.	Feb. 11.	Shares Sold.		Feb. 6.	Feb. 11.	Shares Sold.
All. Ch.....	8½	8*	400	Int. Met., pfd	54¼	55	11,140
All. Ch., pfd.	33⅛	32½*	800	Mackay Cos.	94⅜	94*	500
Amal. Cop...	66½	66	74,050	Mackay C.,pf.	76⅛	76¼*	455
Am. D. T....	20½*	20½*	———	Man. Elev...	139¾	139¾*	500
Am. Loco....	42¼	41½*	2,750	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	110	110*	125	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	83½*	84½*	200	Steel, com...	81¼	81½	509,350
Am. T. & T..	145⅝	145	7,800	Steel, pfd....	121⅞	119	6,000
B. R. T.....	78¾	78⅝	16,970	W. U. T....	74¾	74¾*	2,300
Gen. Elec....	154¾	155½	2,600	West'h, com.	70	70*	1,000
Int. Met.....	19¾	20¼	5,200	West'h, pfd..	119*	119*	———

PHILADELPHIA.

	Feb. 6.	Feb. 11.		Feb. 6.	Feb. 11.
Am. Rys.....	45	44½*	Phila. Elec.....	16¾	16⅜
Elec. Co. of A....	12¼	12⅛*	Phila. R. T.....	20⅜	20¼
Elec. St. B'ty.....	55½	54	Phila. Trac.....	86½*	85¾
E. S. B'ty., pfd....	30*	30*	Union Trac.....	47¾	47¾

CHICAGO.

	Feb. 6.	Feb. 11.		Feb. 6.	Feb. 11.
Chi. City Ry.....	185*	185	Chi. Tel. Co.....	118½	122½
Chi. Rs., Ser. 1.....	93*	93*	Met. El. Co.....	20*	20*
Chi. Rs., Ser. 2.....	24¾	25	Met. El., pfd.....	65*	65½*
Com. Edison.....	115	115	Nat'l Car.....	117*	117*
Chi. Subways.....	4*	4*	Nat'l Car., pfd.....	118*	118*

BOSTON.

	Feb. 6.	Feb. 11.		Feb. 6.	Feb. 11.
Am. T. & T.....	145¾	145½	Mex. Tel.....	4¾*	4¾*
Cum. Tel.....	147⅜	148*	Mex. Tel., pfd.....	7	7*
Edison E., Ill.....	292	291*	N. E. Tel.....	140	142*
Gen. Elec.....	155	155¼	W. T. & T.....	22½	20
Mass. E. Ry.....	18½*	17½*	W. T. & T., pfd....	97*	96*
Mass. E. Ry., pfd...	87½	88			

*Last price quoted.
Shares sold for week Feb. 6 to Feb. 11.

FINANCIAL NOTES.

Metropolitan West Side Elevated Railway Company, Chicago.—For the calendar year 1910 the Metropolitan West Side Elevated Railway Company, of Chicago, reports gross earnings of $3,069,945 and net earnings of $1,513,929. These compare with $2,818,430 and $1,418,076 respectively for the preceding year, the percentages gained being 8.9 per cent and 8.1 per cent. The ratio of operating expenses to gross earnings for the year 1910 was 50.69 per cent. The total charges against income for the year 1910 were $1,079,968, leaving a surplus of $442,731 available for dividends. Of this amount, $261,237 was distributed in dividends and $181,494 carried to surplus, the total surplus now standing at $1,712,118. The company has $9,000,000 preferred stock, $7,500,000 common stock and $15,000,000 in bonds. The daily average number of passengers carried during the year was 156,794, an increase of 8.23 per cent compared with 1909. President Britton I. Budd and the other officers and directors were re-elected.

Chicago Pneumatic Tool Company.—For the year 1910 the Chicago Pneumatic Tool Company reports profits of $1,054,809. After deducting bond interest, depreciation and other charges there remains $694,926, or 10.77 per cent on the $6,485,800 stock outstanding. This figure compares with 3.86 per cent in 1909 and 0.33 per cent in 1908. The present dividend rate is 4 per cent. The year was the best in the history of the company, the profits being twice as large as in 1909, and somewhat larger than in the previous record year of 1906. In his report to the stockholders President W. O. Duntley said that during the year practically all the plants were operated to their full capacity. Early in the year the development and manufacture of a light motor truck for commercial use was begun, and while this branch of the business is yet only in its infancy the indications are that it will be developed rapidly.

Consolidated Gas & Electric of Baltimore.—The board of directors of the Consolidated Gas, Electric Light & Power Company, of Baltimore, at a meeting last week declared a quarterly dividend of 1 per cent on its common stock, payable on Feb. 15, to the stockholders of record at the close of business on Feb. 8, 1911. In adopting quarterly dividends on the common stock of the company, it was announced that this was only another step toward popularizing the securities and shares of the company, and that the policy of the company is in every possible way to encourage the small investor to invest in securities in Baltimore rather than to look elsewhere. The vacancy on the board of directors caused by the death of General Ferdinand C. Latrobe was filled by the election of John L. Bailey. Mr. Bailey is the treasurer of the company, which office he has filled since Jan. 1, 1908, when he succeeded the late Joseph W. Clark.

Rumored Allis-Chalmers Merger.—There has been a persistent rumor in financial circles during the past week that a merger is being negotiated between the Allis-Chalmers Company and the American Steel Foundries Company. These companies are already closely allied in the fact that Judge Elbert H. Gary, W. V. Kelley and Max Pam are on the executive committee of each of them. The consolidation has been hinted at ever since D. W. Call, an official of the American Steel Foundries Company, was recently elected president of the Allis-Chalmers Company. Mr. Kelley denies positively that any merger is contemplated and says that he can see no reason why such a merger would be desirable. Officials of the Allis-Chalmers Company also make positive denials.

Minneapolis Street Railway.—The preliminary announcement has been made by Willard J. Hield, vice-president of the Minneapolis Street Railway Company, which is controlled by the Twin City Rapid Transit Company, concerning the proposed improvements to be undertaken in 1911. These will include the completion of an addition of 50 per cent to the power generation at the steam plant; the installation of more boiler capacity, better stoking equipment and smoke consumers. It is estimated that the total cost of the improvements will be in the neighborhood of $1,000,000. The installation of a 14,000-kw steam-turbine unit and auxiliary apparatus which was begun last year will be completed.

Providence Telephone Company—At the annual meeting of the stockholders of the Providence Telephone Company last week an increase in capital stock from $3,000,000 to $5,000,000 was authorized. The directors later voted to issue $500,000 of the new stock for subscription at par to stockholders of record Feb. 9.

Sterling Electric Company Reorganized.—The Sterling Electric Company, of Lafayette. Ind., has been reorganized and the name changed to the Sterling Electric Works. The new company is capitalized at $200,000 and officers have been elected as follows: President, Samuel T. Murdock; vice-president, R. B. Wallace; secretary-treasurer, Thomas Duncan. Of the $200,000 of stock, $50,000 will be held in reserve.

Titusville Company Sold.—It is reported that the Titusville (Pa.) Electric Light & Power Company has been purchased by a number of electrical men of Philadelphia and other Pennsylvania cities, including Messrs. E. F. McCabe, William M. Measey, H. L. Elkins, Charles S. Boll and Frank G. Kennedy, Jr. The new owners have taken possession of the property, and Mr. McCabe will be in charge.

Kings County Electric Light & Power Company.—James N. Wallace, president of the Central Trust Company of New York, was last week elected a director in the Kings County Electric Light & Power Company in the place of the late Hugh Grant. Mr. Wallace also succeeded Mr. Grant as a director of the New York Edison Company.

Mississippi River Power Distributing Company.—Arrangements have been made by the Mississippi River Power Distributing Company for the issuance of a large block of bonds to provide funds to carry on the work of completing the big dam at Keokuk, Ia. The amount of the issue has not been definitely settled, but it is understood that the bonds will be placed by Stone & Webster, of Boston. The Mississippi River Power Distributing Company owns the entire capital stock of the Keokuk & Hamilton Water Power Company, which has under construction transmission lines from Keokuk to St. Louis. The energy will be delivered to a transformer station to be built by this company in St. Louis. The Union Electric Light & Power Company, of St. Louis, has recently purchased the contract for energy which the Laclede Gas Light Company made with the Keokuk Power Company through the North American Company. After the North American Company disposed of the Laclede company the new management of that concern desired to be rid of the contract. This contract calls for $98,000 worth of power and runs ninety-nine years. The Union Electric Light & Power Company now has a contract with the Keokuk company for 60,000 hp. The Laclede company is rebuilding its steam plant in St. Louis which was burned in 1907.

United Gas & Electric Company.—The United Gas & Electric Company, of 40 Wall Street, New York, has filed a certificate with the Secretary of State of New York, increasing the capital stock from $4,000,000 to $5,500,000 by the addition of $1,500,000 of common. The present authorized capital is $2,500,000 common and $1,500,000 preferred. The new capitalization will be $4,000,000 common and $1,500,000 preferred. The preferred is 5 per cent cumulative. All of the common stock of the United Gas & Electric Company is owned by the Susquehanna Railway Light & Power Company. The United, in turn, owns quite a number of gas and electric companies in widely scattered sections. The principal electric companies are: Colorado Springs Electric Company, Colorado Springs Light & Power Company, Elmira (N. Y.) Water, Light & Railroad Company, Leavenworth (Kan.) Light Heat & Power Company, Lockport (N. Y.) Light, Heat & Power Company, Pike's Peak Hydroelectric Company, Richmond (Ind.) Light, Heat & Power Company and the Union Gas & Electric Company, Bloomington, Ill.

Trumbull Electric Company.—At a special meeting of the stockholders of the Trumbull Electric Company, of Plainville, Conn., last week, it was voted to increase the capital stock from $100,000 to $500,000. The increase will be divided equally between preferred and common. The preferred will carry a 7 per cent dividend. The company also elected four new members of the board of directors, who were: A. J. Sloper and Judge J. E. Cooper, of New Britain, Conn.; Carl W. Jones and Stanley W. Gwillim. The directors elected John H. Trumbull, president; Frank T. Wheeler, vice-president, and Henry Trumbull, secretary and treasurer. The Trumbull Electric Company manufactures electric switches and other electric fixtures, and the common stock is all held by the officers of the company. Mr. Sloper and his friends are said to have acquired all of the $200,000 of new preferred stock. It is proposed to build a large addition to the plant at Plainville, and greatly extend the manufacturing operations.

Northern States Power Company.—H. M. Byllesby & Company, of Chicago, have issued an attractive booklet containing handsomely illustrated articles pertaining to the public-utility properties managed by them. These embrace electric light and power, gas, steam-heating and street-railway enterprises in thirteen Western and Northwestern States. Twenty-five municipalities in the Northwest are served by properties which are held by the Northern States Power Company, which is under the direction of Byllesby & Company. The booklet states that these properties are all in productive territory and that the opportunities for increasing the volume of business and augmenting earnings are unusually attractive. Several large water-power enterprises are now under construction which will reduce the operating expenses and eliminate competition.

Annual Report of Chicago Telephone Company.—At the annual meeting of the Chicago Telephone Company on Feb. 8 the gross revenue of the company for the year 1910 was shown to be $11,331,153. The general and operating expenses amounted to $5,187,547 and repairs and maintenance to $3,888,532, leaving net earnings of $2,255,072, from which $2,160,000 was paid in dividends. The net earnings were equal to 8.35 per cent on the capital stock. This figure compares with 8.22 per cent in 1909 and 7.62 per cent in 1908. The increase in gross revenue over 1909 was about 15 per cent, but expenses increased over 17 per cent. The number of telephones connected to the system increased 38,259 during the year, and the number of employees is 9370. The company has $27,000,000 in capital stock and a bonded debt of $5,000,000. Other liabilities include "replacement reserves" of $4,113,644. This is a new account. It includes "reserve for depreciation" and "surplus" as of Dec. 31, 1909; also that portion of net earnings of 1910 charged to depreciation and several items transferred from "miscellaneous reserves." These amounts are invested in the company's plant. John M. Clark, for a number of years president of the company and later chairman of the board of directors, retired as a director of the company. He was succeeded by Angus S. Hibbard, general manager of the company.

Pacific Power & Light Company.—It was announced last week that the Pacific Power & Light Company had definitely determined to construct its new hydroelectric plant at Pasco, Wash. This station will ultimately cost $500,000. The property and franchises necessary for its development have already been secured. The first unit of the plant will cost about $83,000 and work is to be begun upon it as soon as the plans are completed. As soon as it becomes necessary further units are to be added. The new plant will care for the transmission lines feeding the Yakima Valley and the lines to Walla Walla and Lind, where a connection will be made with the line of the Washington Water Power Company. It will also supply the lines to Hanford, Priest Rapids, Kennewick and various shorter lines to irrigation projects.

Philadelphia Rapid Transit.—The directors of the Philadelphia Rapid Transit Company have authorized a call for proxies from the stockholders for a special meeting to be held Feb. 28 to sanction the new financing plan. The committee of two of the Union Traction directorate made its final report on this plan to the directors of the Rapid Transit Company last week, and the report was approved by the board. This is the plan that was outlined by E. T. Stotesbury, before he became a director in the companies, to take charge of the financing of the traction properties.

American District Telegraph Company.—At the annual meeting of the American District Telegraph Company of New York last week the balance sheet showed assets of $4,466,954. The surplus on hand was $597,326. While the business of the company increased during the past year the annual report states that the earnings in the future are somewhat uncertain, owing to the additional cost of messenger labor made necessary by recent legislation. The net earnings for the year were $88,504.

Heavy Increase in Traffic.—A table prepared last week by Dr. A. F. Weber, chief statistician of the Public Service Commission, shows that during the year 1910 the total ticket sales on the New York elevated system were 299,415,317 as against 270,221,490 on the subways. This shows an increase on the elevated lines over the previous year of 13,011 524, or about 4.54 per cent, and on the subways an increase of 13,452,509, or 5.24 per cent.

Lynn Gas & Electric Company.—The net earnings of the Lynn (Mass.) Gas. & Electric Company for 1910 were $3,608,806, which is almost 37 per cent on the $1,000,000 of capital stock. Since 1901 the net earnings of the company have increased threefold. For the nine years from 1901 through 1909 the stockholders have received cash payments of $155 per share, averaging 17 and 22 per cent.

DIVIDENDS.

Detroit United Railway Company, quarterly, 1¼ per cent, payable March 1.

General Electric Company, quarterly, 2 per cent, payable April 15.

Kings County Electric Light & Power Company, quarterly, 2 per cent, payable March 1.

Pacific Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Feb. 15.

Philadelphia Electric Company, quarterly, 1½ per cent, payable March 15.

Rochester Railway & Light Company, preferred, quarterly, 1¼ per cent, payable March 1.

Susquehanna Railway, Light & Power Company, preferred, semi-annual, 2½ per cent, payable March 1.

Tampa Electric Company, quarterly, 2 per cent, payable Feb. 15.

General News

Construction News.

DOTHAN, ALA.—Plans are being considered for increasing the output of the municipal electric plant by 200 per cent and moving it to a new site. B. R. Pilcher is manager.

TEMPE, ARIZ.—The Tempe Light & Power Company has applied to the City Council for permission to assign its franchises to the South Side Gas & Electric Company.

ASHDOWN, ARK.—The construction of a municipal electric-light plant in Ashdown is reported to be under consideration.

CLARKSVILLE, ARK.—It is reported that the electric-light plant, lumber mill and planing mill owned by E. J. Connell was recently destroyed by fire, causing a loss of about $35,000. It is understood that the plant will be rebuilt.

HELENA, ARK.—The Helena Gas & Electric Company, recently incorporated, it is reported, will take over the plant and holdings of the Helena Gas Company. It is said that the new company contemplates improvements to the plant, including the installation of additional machinery. Claude S. Fitzpatrick and J. B. Miles, Jr., are among the incorporators.

LITTLE ROCK, ARK.—The Little Rock Railway & Electric Company has recently purchased a 2500-kw Curtis turbine from the General Electric Company, of Schenectady, N. Y., for its power plant at Little Rock.

MONTICELLO, ARK.—The municipal electric-light and power plant is reported to have been destroyed by fire recently, entailing a loss of about $15,000. The town will be without light or water service until arrangements can be made to secure power and necessary machinery installed.

SMITHVILLE, ARK.—The Farmers' Mutual Telephone Company, recently organized with headquarters at Smithville, is planning to erect telephone lines to Imboden and other points in Lawrence County. N. L. Dunahue is president.

COLUSA, CAL.—Notices of three water appropriations have been filed by Byron D. Beckwith; one on Fresh Water Creek, one on Bear Creek in Colusa County and the other on Cache Creek in Lake County. The water is to be used for both power and irrigation purposes. It is proposed to erect a dam on Bear Creek and utilize the lower end of Bear Valley as a reservoir. The present plans include tunneling through the hill easterly from Bear Valley to the head of Fresh Water Creek and to divert the water past the Mountain House, utilizing it at the outlet of the tunnel for power. It is proposed to erect three power stations. Below the Mountain House the water will be used for irrigation.

LIVE OAK, CAL.—Negotiations have been closed whereby Henry Berg, Jr., and Nathan Metz, of Marysville, have purchased the property of the Live Oak & Encinal Light & Power Company. The consideration is said to be $10,000. The owners, it is said, will extend the transmission lines over Sutter County to supply electricity to operate the electric pumping plants to be established throughout the county for irrigating purposes.

LOS ANGELES, CAL.—The Los Angeles Railway Company has applied to the City Council for permission to equip the old Santa Monica steam railroad for electrical operation. This road extends from Clemente Junction, at Thirty-eighth and Alameda Strects, west across the city to Santa Monica, a distance of about eighteen miles.

OAKLAND, CAL.—The Oakland Traction Company is planning to construct twenty miles of new track in Oakland, contracts for which will be placed during the next six weeks.

SAN FRANCISCO, CAL.—Bids will be received at the office of the Constructing Quartermaster, Fort Mason, Cal., until March 1 for constructing addition to power house and installing pumping machinery at the United States army general hospital, Presidio of San Francisco, Cal. Plans and specifications can be secured at the above office, for which a deposit of $10 will be required, which will be returned upon receipt of plans. Major George McK. Williamson is quartermaster.

SAN FRANCISCO, CAL.—The Board of Public Works has decided to request the Board of Supervisors to issue $600,000 of the Geary Street railway bonds in addition to the $500,000 already disposed of. City Engineer Manson states in his report to the board that of the $500,000 already issued the proceeds of $218,000 have been set aside for the purchase of rails, ties and other track material and equipment, and $880,000 more will be needed at once to provide for the following: Special track work, $60,000; land for power house, car house, etc., $140,000; cars, $300,000; construction of buildings, $80,000, and for construction of track and overhead work, $300,000.

SIMSBURY, CONN.—E. C. Buckland, vice-president of the New York, New Haven & Hartford Railroad Company, has informed the committee appointed by the town to ask for better railway accommodations into Hartford that the company will equip the eastern end of the Central New England Railroad and its New Hartford branch for electrical operation, so as to provide electric service between Hartford and Simsbury, Collinsville, New Hartford and Winsted. The New Haven company has applied to the Legislature for a charter to operate an electric railway north from New Hartford, through Barkhamsted and Colebrook to the Massachusetts line, and is also asking the Massachusetts Legislature for the right to construct part of the railway in that State which will connect New Hartford with the Berkshire towns.

SOUTH NORWALK, CONN.—Announcement has been made by the Housatonic Light & Power Company of a reduction in the price of electricity for lamps, amounting to about 20 per cent. Under the new schedule of rates no discount will be allowed. The rates are as follows: From 1 to 49 kw-hours, 12 cents per kw-hour; from 50 to 99 kw-hours, 11½ cents; from 100 to 149 kw-hours, 11 cents; from 150 to 199 kw-hours, 10½ cents; from 200 to 299 kw-hours, 10 cents; from 300 to 399 kw-hours, 9½ cents; from 400 to 499 kw-hours, 9 cents, and from 500 kw-hours upward, 8½ cents. The minimum charge is $1 per month. The reduction was voluntary on part of the company. George H. Caffrey is superintendent of the local division.

WESTPORT, CONN.—It is reported that the Westport Water Company is planning to make improvements to its plant and proposes to duplicate the present equipment in the power station.

WASHINGTON, D. C.—Sealed proposals will be received until Feb. 27 at the office of the Chief Signal Officer, War Department, Washington, D. C., for furnishing under Proposal No. 501 300 miles of field wire, 11-strand, on spools, in lengths of 2640 ft., spools to be furnished by the signal corps. For further information address Captain A. S. Cowan, purchasing officer.

WASHINGTON, D. C.—The House of Representatives on Feb. 7 defeated the bill introduced by Representative Molly, of New York, giving the Long Sault Development Company the right to construct and maintain locks, dams, canals and power houses in the St. Lawrence River, near Long Sault, Barnhart and Sheek Islands, N. Y., to utilize the water-power of that river. The bill was also opposed in Canada.

LIVE OAK, FLA.—The Live Oak Electric Company, recently organized, is reported to have purchased the local electric light plant and planing mill. It is understood that the consideration for the electric plant was $40,000. Harry J. Wood is president and treasurer, C. E. Jones vice-president and A. Lee Humphreys secretary of the new company.

DALTON, GA.—It is reported that the Ocoee Power Company, of Chattanooga, Tenn., is contemplating erecting a transmission line from its plant on the Ocoee River, near Cleveland, into Dalton.

MINERAL BLUFF, GA.—The Pure Food Milling Company is reported to be negotiating with the Municipal Electric Light and Water Commission, of Blue Ridge, Ga., to supply electricity in Blue Ridge for lamps and motors. The cost of extending the transmission line from Blue Ridge to Mineral Bluff is estimated at $2,500.

TALLULAH, GA.—It is reported that arrangements have been completed by the Georgia Power Company to begin work on the hydroelectric development at Tallulah Falls, where it is estimated that 100,000 hp can be developed. The work will include the erection of a dam 100 ft. high and to tunnel water 1¼ miles to secure 600-ft. fall; construction of steel towers to carry transmission lines to Atlanta, Ga., ninety miles distant, where a large distributing station will be erected. Electricity will be transmitted at 11,000 volts; a distributing station will also be erected near Tallulah and electricity transmitted over 300 miles of wire; machinery will include six electric generators having a rating of 15,000 kw each. All contracts will be awarded through the Northern Contracting Company, of Detroit, Mich., and New York, N. Y. C. Elmer Smith, of York, Pa., is president of the company. C. O. Lenz, 71 Broadway, New York, N. Y., is engineer in charge.

THOMSON, GA.—Preparations are being made to establish a day service in connection with the municipal electric plant at once. L. J. Porter is superintendent.

DIXIE, IDAHO.—Announcement has been made by the Idaho Realty & Power Company, which owns the greater portion of Dixie townsite as well as water rights for about three miles along Crooked Creek, that it will begin work on the installation of a power plant to supply electricity to operate its own placers and other mines in this vicinity and also for illuminating purposes.

GILMORE, IDAHO.—It is reported that preparations are being made for the installation of a 600-hp power plant to supply electricity for lamps and motors in Gilmore and for operating the machinery in the Gilmore mines.

HOPE, IDAHO.—The citizens of Hope are considering the question of installing an electric-light and power plant. There is a good water-power within the town limits which could be developed to provide power for operating the plant. For further information address J. H. Sierman, vice-president.

PIERCE CITY, IDAHO.—The Sprague Company is reported to be contemplating the construction of a hydroelectric power plant. The proposed plant will be located about two miles above Pierce City and will supply electricity to operate the mines of the Sprague Company.

the Idaho Placer Company, and also the Ozark quartz mine. Paul F. Hare is manager.

BELVIDERE, ILL.—The Public Service Operating Company has recently been awarded a new contract for street lighting, under which it is to install a new system within the next three months. It is proposed to install either the General Electric magnetite system or the Westinghouse metallic flame arc lamps. It is now expected to install two 50-lamp circuits and one 75-lamp circuit. T. C. McKeen is manager.

CHICAGO, ILL.—The Board of Trustees of the Sanitary District of Chicago has rejected all bids received for a transformer for the seventh unit to be installed at Lockport and has authorized Isaac Bryant, clerk, to advertise for new bids.

CHICAGO, ILL.—Plans are being made to form a new company for the purpose of combining the franchises of the Northwestern Elevated Railroad Company and the Chicago & Milwaukee Electric Railway. This will give the interurban cars from Milwaukee and the North Shore access to the heart of the city without changing at Evanston. Mason B. Starring, president of the Northwestern Elevated Railway Company, is to head the new company.

PINCKNEYVILLE, ILL.—The Farmers' Telephone Organization, formed by the farmers of Perry County, is planning to install a switchboard at Pinckneyville. W. F. Bills, of Swanwick, is president, and Charles Schmairiede, of Pinckneyville, is secretary and treasurer.

ANDERSON, IND.—The annual report of the municipal electric light plant shows total earnings for 1910 of $99,000; expenditures, including repairs and operating expenses, of $45,687, leaving a balance of $53,313. The street-lighting system includes 290 arc lamps, the cost of which is estimated at $64.14 each per year.

ELKHART, IND.—A new telephone company has been organized under the direction of H. D. Critchfield, of the Automatic Electric Company, of Chicago, Ill., and a franchise will be asked to install and operate an automatic telephone system in Elkhart.

INDIANAPOLIS, IND.—The Indiana Legislature has made appropriation for the following work: For rewiring the Northern Hospital for the Insane at Logansport, $15,000; for power plant for Indiana University at Bloomington, $10,800; for rewiring Indiana Reformatory at Jeffersonville, $2,375, and for outside electric lighting system at the School for Deaf, $2,000.

KOKOMO, IND.—The Kokomo, Marion & Western Traction is reported to be planning to build an extension from Kokomo to Frankfort, twenty-seven miles in length, during 1911.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company, which operates a lighting plant in Kokomo, has filed amendments to its charter with the Secretary of State, allowing the company to install and operate a steam-heating plant in this city. The company proposes to utilize exhaust steam to operate the heating plant. George J. Marott is president.

LOGANSPORT, IND.—It is reported that plans are being prepared by the Central Station Engineering Company, 164 Dearborn Street, Chicago, Ill., for extensions and improvements to municipal electric-light plant and lighting sytem at Logansport.

MARION, IND.—Arrangements have been made by the citizens to bring suit to test the validity of the contract made by the City Council with the Marion Light & Heating Company for lighting the streets for a period of ten years. It is contended that the action of the Council will convert the municipal electric light plant into junk and practically destroy all prospects of the city obtaining a municipal plant for commercial lighting.

PORTLAND, IND.—The City Council has granted the Como Telephone Company a franchise to install a telephone system in Portland.

SOUTH BEND, IND.—The Chicago, South Bend & Northern Indiana Railway Company has decided to double-track its railway on several streets in this city at a cost of about $75,000.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company has reduced the rate in South Bend for electricity for lamps from 12 cents to 10½ cents per kw-hour. The reduction was voluntary on the part of the company.

AFTON, IA.—The proposition to install an electric-light system in Afton, it is said, will be submitted to a vote.

DAVENPORT, IA.—The Tri-City Railway Company is planning to build an extension between Davenport and Muscatine, requiring thirty-five miles of track, and also five miles of new track in Davenport and Muscatine during the coming year.

PLYMOUTH, IA.—Local business men are considering the question of erecting a dam in the Shell Rock River to furnish power to operate an electric-light plant in Plymouth.

ATCHISON, KAN.—The Atchison Railway, Light & Power Company is reported to have submitted a proposition to the citizens of Rushville to supply electricity for lamps and motors provided the town would build the transmission line connecting the two places. The power plant at Rushville was recently destroyed by an explosion.

FAIRVIEW, KAN.—It is reported that bonds to the amount of $3,500 have been voted for the installation of an electric-light plant in Fairview.

LURAY, KAN.—The installation of an electric light plant and waterworks system in Luray is reported to be under consideration.

PITTSBURG, KAN.—Plans are being prepared by the Joplin & Pittsburg Railway Company for the erection of a power plant in Pittsburg. The company also expects to purchase one 400-kw generator, one 600-hp engine and one 150-hp boiler for the new plant. This item by mistake was printed under Pittsburgh, Pa., in the issue of Feb. 9. The company is also planning to extend the railway to connect with the city park in Pittsburg. William A. Satterlee, of Pittsburg, Kan., is purchasing agent.

SPEARVILLE, KAN.—The Commercial Club is advocating the establishment of an electric light plant in Spearville. It is reported that Ira Hickman is interested in a company which proposes to install a plant here.

SYLVAN GROVE, KAN.—The question of installing an electric light plant and water-works system in Sylvan Grove, to cost about $17,000, is reported to be under consideration.

CLINTON, KY.—The Clinton Water & Light Company is reported to be contemplating the installation of an ice plant.

LEXINGTON, KY.—The Kentucky Securities Company, recently incorporated for the purpose of taking over the traction properties owned and controlled by the Lexington & Interurban Railways Company, is preparing plans for rebuilding the entire street railway system of Lexington and various interurban lines extending to the surrounding towns, including the construction of a large power plant in this city. The proposed work will involve an expenditure of more than $1,000,000.

PADUCAH, KY.—A committee has been appointed by the Commercial Club, of which S. B. Caldwell is chairman, to look into the proposition of constructing an electric railway from Paducah to Fulton, Ky., by the way of La Center, Wickliffe, Mayfield and Murray. E. Q. Lockyear, of Evansville, Ind., is promoter.

PAINTSVILLE, KY.—It is reported that a company is being organized in Paintsville to install an electric light plant. H. La Vier, Clarence W. Howes, H. M. Stafford and D. J. Wheeler are interested in the project.

SHELBYVILLE, KY.—It is reported that N. B. Waugh, of Shelbyville, Ky., who is promoting the construction of an electric railway from Shelbyville to Mount Eden, has secured financial backing for the project and is now securing rights of way for the proposed road.

NEW IBERIA, LA.—The Southwestern Power & Traction Company, which proposes to build an electric railway from New Iberia to Lafayette, La., is planning to erect a power plant in New Iberia and substations along the route of the proposed railway. It is understood that the company will supply electricity for industrial plants along the route of its railway. F. W. Crosby, of New Orleans, La., is president.

BALTIMORE, MD.—Announcement has been made that Robert J. McCuen, superintendent of lamps and lighting, would make a recommendation to the Council and Board of Estimates that an independent franchise be given to the Patapsco Water & Power Company to supply electricity in Baltimore in order that it might compete with the Consolidated Gas, Electric Light & Power Company to supply electrical service to the municipal buildings. The company has submitted a proposition to the city offering to supply electricity for the municipal buildings at the rate of 2 cents per kw-hour if granted a franchise. The lowest price given by the Consolidated company is 3 cents per kw-hour under the existing contract, which expires June 1. Victor G. Bloede is president of the Patapsco Electric Company.

HAGERSTOWN, MD.—Wilbur J. Bragonier, Charles W. Wolfensberger and Daniel C. Gilbert have organized a company under the name of the Hagerstown Electric Park Company for the purpose of establishing an amusement resort. The capital stock is placed at $5,000.

BOSTON, MASS.—The School Board has passed a resolution providing for the installation of an independent electric light plant, to cost $7,000. The proposed plant will be equipped with gas engines and will supply electricity to the Eliot, Christopher, Columbus, Paul Revere, Hancock and Cushman schools in the North End.

NORTH ADAMS, MASS.—The City Council has adopted a resolution authorizing a committee of five to investigate the question of municipal ownership of gas and electric light plants, either by purchase or installation of new plants.

PALMER, MASS.—The Central Massachusetts Electric Company is contemplating extending its system across the bridge at North Wilbraham into the eastern end of Ludlow to supply electricity for lamps and motors to that section of the town.

PITTSFIELD, MASS.—Plans are being made by the Berkshire Street Railway Company for the construction of an extension, thirty miles in length, to connect Great Barrington, Hunting and Berkshire.

STERLING, MASS.—At a special town meeting held recently the citizens voted to install an electric light system in Sterling. The Selectmen were authorized to secure funds for completion of the work.

LANSING, MICH.—It is reported that surveys are being made by the Michigan United Railways Company for an extension of its system to Chesaning.

LANSING, MICH.—Plans are being considered by the Michigan United Railways Company for installing its own power plants, for which surveys are now being made under G. N. Lemon, chief electrical engineer, with headquarters in Jackson. The company now secures electricity for operating its system from the Commonwealth Power Company, of Jackson, Mich.

HIBBING, MINN.—The Council has decided to change the voltage of the municipal electric-light plant from 1100 volts to 2200 volts.

DULUTH, MINN.—It is reported that prominent Michigan capitalists who are interested in the White Iron Lake Iron & Water Power Company are contemplating the construction of a dam 12 ft. high, which would back the water for nineteen miles in the White Iron and Birch lakes. It is estimated that 25,000 hp could be developed. The company, it is said, proposes to supply electricity to the mines at Tower and Ely and vicinity and to the sawmill at Vinton. H. C. Kendall is president of the company; Frank H. Cutting, vice-president; William S. Eaton, secretary, and R. H. Eagan, treasurer.

MINNEAPOLIS, MINN.—Resolutions have been introduced in the City Council instructing the Twin City Rapid Transit Company to make several extensions to its system, to be completed and in operation within ten months.

MINNEAPOLIS, MINN.—The City Council has decided to advertise for bids for furnishing electricity for street lighting for one, three and five years. The service is now furnished by the Minneapolis General Electric Company, which charges $84 per year per lamp, although the city pays only $70 each as provided by the Walker rates.

NORTH BRANCH, MINN.—A company is being organized to install an electric light plant in North Branch to supply electricity in this and surrounding towns. The company is to be capitalized at $50,000. Mr. Spivak is interested in the project.

SAUK RAPIDS, MINN.—It is reported that the bill authorizing the construction of the Sauk Rapids dam has been passed. It is expected that work on construction of the dam will begin in the spring.

MERIDIAN, MISS.—The Mississippi Home Telephone Company is contemplating the extension of its long-distance service to towns in adjacent states. The first connection will be made with New Orleans, La.; Memphis, Tenn., and Shreveport, La. The proposed work will involve an expenditure of $2,500,000.

BURLINGTON JUNCTION, MO.—At a special election held recently it is reported that the citizens voted to purchase the plant of the Burlington Junction Electric Light & Power Company, for which bonds to the amount of $8,500 were authorized. The plant will be improved and operated by the municipality. The plant was established about three years ago.

CANTON, MO.—Steps have been taken by the Commercial Club, of Canton, Mo., to secure the construction of an electric railway from Canton to Memphis, Mo., via Monticello. It is said that two routes are under consideration, either of which can be built at a cost not to exceed $160,000.

IRONDALE, MO.—It is reported that preliminary arrangements are being made for the construction of a hydroelectric power plant and electric railway in Irondale. James P. Ward, of Irondale, is said to be interested in the project.

WEST PLAINS, MO.—The local telephone system is reported to have been sold to J. W. Boyer, of Jennings, La.

BILLINGS, MONT.—Preliminary arrangements are being made by the Billings Traction Company for the construction of its proposed electric railway, work on which will begin in the spring.

GREAT FALLS, MONT.—Preparations are being made to replace the equipment of the power plant of the Great Falls Electric Properties, recently destroyed by fire. E. I. Holland, of Great Falls, is manager.

POLSON, MONT.—It is reported that active construction work will begin early in the spring on a hydroelectric power plant which will supply electricity in Polsen and vicinity. The power site, which is a natural one of 800-ft. effective head, is located within eight miles of this city. Frank Faucett, of Polsen, is engineer.

UTICA, NEB.—The proposition to issue $5,000 in bonds, the proceeds to be used for the installation of an electric-light plant in Utica, is reported to be under consideration.

JAFFREY, N. H.—The State Legislature has passed a bill authorizing the town of Jaffrey to construct and maintain an electric light and power plant.

CALDWELL, N. J.—It is reported that the incorporators of the Pine Brook Electric Railway Company, which proposes to operate an electric railway between Caldwell and Denville, a distance of about thirty miles, has decided to equip the road with storage-battery cars. The cost of construction of the railway is estimated at about $18,000 per mile.

SOUTH ORANGE, N. J.—The Sillcocks-Miller Company is erecting a factory at South Orange, N. J., 50 ft. x 100 ft., three stories high, with power house adjoining. A modern ventilating system and a small power plant will be installed. The company manufactures artificial leather specialties, celluloid novelties, etc. W. S. Sillcocks is president of the company.

LAS CRUCES, N. M.—The Water Users' Association of the upper Rio Grande Valley and others who will be directly benefited by the fulfilment of the Elephant Butte Dam and land reclamation project by the government are interested in the legislation which is now pending in Congress to permit the organization of an electric power and transmission company to be operated in conjunction with the large irrigation enterprise. The bill empowers the Secretary of the Interior to lease power sites on reclamation dams for a longer period than ten years. If the measure is favorably acted upon by Congress a subsidiary company of the Water Users' Association will be immediately organized. It will be capitalized at $3,000,000, the stock to be apportioned among the members of the Water Users' Association in proportion to the number of acres of land that they may have under irrigation. The purpose of the organization is to erect a hydroelectric power plant to provide electricity for operating various industries in the Rio Grande Valley and also to construct and operate an electric railway in connection with the enterprise, to extend from the dam site at Elephant Butte down the valley through El Paso to Fort Hancock, a distance of more than 100 miles. Richard Burges, attorney, of El Paso, Tex., is representing the association at Washington. Felix Martinez, of El Paso, is one of the promoters of the power and electric railway project.

BUFFALO, N. Y.—It is reported that a company is being organized by parties interested in the International Railway Company, of Buffalo, N. Y., for the purpose of constructing and operating an electric railway through Abbott Road from Cazenovia Street to the south city line of Buffalo. It is understood that it will connect with the Buffalo Southern Railway, which now enters the city at South Park Avenue. The new company will be capitalized at $100,000. Morris Cohn, of Niagara Falls, N. Y.; Thomas E. Mitten, of Chicago, Ill.; Edmund B. Osler, of Toronto, Ont., Can., and others are interested.

FULTON, N. Y.—The Oswego River Power Transmission Company, of Syracuse, has applied to the City Council for a franchise to erect a transmission system for distributing electricity for lamps, heat and motors in Fulton. Eugene M. White is attorney for the company.

GLOVERSVILLE, N. Y.—Bids will be received by the City of Gloversville until Feb. 21 for lighting the streets of the city by electricity for terms of five and ten years. Not less than 132 arc lamps and 194 incandescent lamps will be required.

LOCKPORT, N. Y.—The Public Service Commission, Second District, has authorized the Lockport Light, Heat & Power Company to issue bonds to the amount of $70,000, to be sold at not less than $85 and the proceeds to be used for improvements and extensions to its plant and distributing system, and to take up outstanding indebtedness.

LYONS, N. Y.—It is reported that the Crowell-Sherman Stalter Company is contemplating the construction of an electric power plant in Lyons.

NEW YORK, N. Y.—Judge Lacombe in the United States Circuit Court has signed an order authorizing Adrian H. Joline and Douglas Robinson, as receivers of the Metropolitan Street Railway Company, to construct an additional coal hoist at the power station, located at First Avenue and Ninety-sixth Street, the cost not to exceed $50,000.

NEW YORK, N. Y.—The New York, Ontario & Western Railroad Company has issued a large list of tools and equipment which will be required by the company, the cost of which is estimated at about $50,000. The list includes a complete line of machine tools and equipment for a blacksmith shop, most of which will be motor driven. C. A. Draper, 56 Beaver Street, New York, N. Y., is general purchasing agent.

NIAGARA FALLS, N. Y.—The Public Service Commission, Second District, has authorized the Cliff Electrical Distributing Company, of Niagara Falls, N. Y., to issue $250,000 bonds, to be sold at not less than 95, the proceeds to be used for improvements to its plant.

PHOENIX MILLS, N. Y.—Bids are being asked by the County of Otsego for the construction and equipment of a power house in Phoenix Mills, 30 ft. x 50 ft. F. D. B. Ingalls, Rosenbloom Building, Syracuse, N. Y., is engineer.

SYRACUSE, N. Y.—The Auburn & Syracuse Electric Railroad Company is planning to double-track several of its lines in Syracuse during 1911.

WAVERLY, N. Y.—The Elmira, Corning & Waverly Railroad Company has recently purchased from the General Electric Company, of Schenectady, N. Y., three 3000-kw rotary converters with transformers and switchboard for its power house in Corning.

RUTHERFORDTON, N. C.—The Isothermal Traction Company, which is planning to construct an electric railway from Gastonia, via Rutherfordton, to Asheville, a distance of 100 miles, is reported to have applied to the State Legislature for permission to change its name to the North Carolina Interurban Traction Company. K. S. Finch, of Charlotte, N. C., is president.

WILMINGTON, N. C.—Preparations are being made by the Tidewater Power Company for extensions and improvements to its power plant in Wilmington and system at Lumina, Wrightsville Beach. Additional machinery will be installed at the power station, including a 500-kw rotary converter, one 500-hp boiler and 200-kw lighting transformers; the boiler capacity will be increased 50 per cent. The present 150-kw converter will be transferred to the substation at Wrightsville Sound, where it will be used as an auxiliary in cases of emergency. A. B. Skelding is general manager.

FARGO, N. D.—It is reported that the plans to be prepared by the city engineer for the proposed filtration plant and pumping station will include an electric light plant.

NEW LEIPZIG, N. D.—The Home Telephone Company, recently incorporated, is planning to install a local telephone system in the spring. A rural line will be erected, taking in Birdsall, Burt, Mott and Bentley. F. B. Ewald, Jr., of New Leipzig, is interested in the company.

AKRON, OHIO.—The Northern Ohio Traction & Light Company, it is reported, has acquired the right of way for double-tracking its railway between Cuyahoga Falls and Newburg, work on which, it is understood, will begin this spring.

ATHENS, OHIO.—Arrangements are being made by the Hocking-Sunday Creek Traction Company to commence work on construction of

its proposed electric railway between Athens and Nelsonville in April. It is proposed eventually to extend the railway from Nelsonville to Lancaster. E. B. Young, of Nelsonville, Ohio, is president of the company.

CAMDEN, OHIO.—The Camden Telephone Company has increased its capital stock from $20,000 to $30,000.

CINCINNATI, OHIO.—The Cincinnati Traction Company is installing two additional 525-hp Babcock & Wilcox boilers, equipped with Murphy furnaces, in its Pendleton power station.

CINCINNATI, OHIO.—The Ohio Electric Railway Company is reported to have disposed of $6,000,000 in bonds, and $4,000,000 in capital stock, the proceeds of which will be used for improvements and extensions to its properties. Among the railways controlled by the Ohio Electric Railway Company are the Cincinnati, Dayton & Toledo, the Indiana, Columbus & Eastern, the Columbus, Newark & Zanesville, the Dayton & Western and the Lima & Toledo Traction Company.

CLEVELAND, OHIO.—The stockholders of the Cleveland, Painesville & Eastern Railroad Company, of Cleveland, Ohio, it is reported, have voted to increase the capital stock of the company from $2,000,000 to $3,500,000. It is also stated that bonds to the amount of $500,000 have been authorized, the proceeds to be used for extensions and improvements to the system.

COLUMBUS, OHIO.—Preparations are being made by the Columbus, Mt. Vernon & Mansfield Railway Company for the construction of an electric railway to connect Columbus, Mansfield and Mt. Vernon. It is expected that an extension will be built to New Albany and Johnstown. L. P. Stevens is general manager.

FORT RECOVERY, OHIO.—The Fort Recovery Telephone Company has filed amendments to its charter increasing its capital stock from $10,000 to $15,000.

HIRAM, OHIO.—Lloyd M. Hill, proprietor of the local electric light plant, is planning to change the system from direct current to alternating current next July. Mr. Lloyd purchased the Hiram College electric light plant.

LORAIN, OHIO.—It is reported that the Black River Telephone Company, of Lorain, Ohio, is arranging to increase its capital stock from $100,000 to $200,000, the proceeds to be used for the erection of a new building and the installation of a new automatic exchange.

SANDUSKY, OHIO.—The City Council has instructed the Director of Public Service to procure plans and estimates for the installation of a municipal electric-light plant in Sandusky.

SPRINGFIELD, OHIO.—Judge Middleton recently handed down a decision denying the Springfield Light, Heat & Power Company, of Springfield, Ohio, the right to make a minimum charge of $1 per month to consumers. Since the new ordinance fixing the rate at 8 cents per kw-hour went into effect the company has been enforcing this minimum charge, but the court holds that as the company accepted the ordinance fixing a maximum rate it has forfeited its rights to make a minimum charge which would make the rate to any consumer more than the maximum named in the ordinance.

BLISS, OKLA.—The lighting plant owned by Miller Brothers is reported to have been destroyed by fire.

BOLEY, OKLA.—The capital stock of the Boley Light & Power Company has been increased from $5,000 to $20,000.

HEAVENER, OKLA.—The Degna-McConnell Coal Company, of Wilburton, Okla., is reported to have petitioned for a franchise to install and maintain an electric light plant in Heavener.

SAPULPA, OKLA.—The Sapulpa Interurban Railway Company is planning to build an extension of its railway from Sapulpa to Tulsa, a distance of fifteen miles, during 1911.

SNYDER, OKLA.—The proposition to issue $40,000 in bonds for the installation of an electric light plant and enlarging the water-works system will soon be submitted to a vote. The present plans call for an expenditure of $25,000 for installation of electric plant and $15,000 for extensions to the water system.

EUGENE, ORE.—The city attorney has been directed to draw up an ordinance providing for issuing bonds to the amount of $25,000, the proceeds to be used for the installation of a tungsten incandescent street lighting system.

JOSEPH, ORE.—The Joseph Electric Light & Power Company is contemplating erecting a transmission line into the farming section, which will ultimately be extended to Enterprise, six miles distant. Another transmission line six miles long will be erected in another direction to supply electricity for lamps and motors. A day circuit will also be established. J. J. Rejab is superintendent.

KLAMATH FALLS, ORE.—The City Council has granted the Klamath Falls Light & Water Company a 50-year franchise to supply electricity for lamps and motors in Klamath Falls.

PORTLAND, ORE.—Plans are being made by the Mt. Hood Railway & Power Company for the construction of an extension from Portland to Bull Run, twenty-two miles in length, during 1911.

PORTLAND, ORE.—Bids will be received at the office of Whidden & Lewis, architect, 701 Corbett Building, Portland, Ore., until Feb. 23 for furnishing and installing electric combination and gas fixtures in the rooms and corridors of the east wing of the new court house at Multnomah County, plans and specifications for which may be obtained from the architects.

PRINEVILLE, ORE.—Plans are being considered by the Prineville Light & Water Company for improvements and changes to its system during the summer, which will include the installation of hydroelectric power, using long-distance transmission. The present steam power plant will be abandoned. C. L. Shattuck is superintendent.

SHERIDAN, ORE.—It is reported that C. G. Arnold is contemplating the installation of a telephone system in Sheridan, for which application will soon be made for a franchise.

TURNER, ORE.—The Interior Warehouse Company, a subsidiary of Balfour, Guthrie & Co., has been granted a franchise by the City Council to install an electric light plant in Turner. The Council and Mayor are considering the question of lighting the principal streets of the town.

VALE, ORE.—It is expected that the Telluride Power Company will extend the transmission line from its hydroelectric plant on the Malad River, Idaho,, to Vale within the next two months. The company is to erect 150 miles of transmission lines.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal, Washington, D. C., until March 3 for furnishing manganese steel castings, steel castings, wire rope, gear and milling cutters, auger bits, foundry core machine and electric fans. Blanks and general information pertaining to this circular (No. 622) may be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal.

CORAOPOLIS, PA.—Bids will be received at the office of the borough clerk until March 1 for the following apparatus: One 1,500,000-gal. triplex pump, one 150-hp gas engine for driving pump, two 225-hp gas engines to be direct-connected to 175-kva, 2300-volt, 60-cycle, three-phase alternating-current generators, one 75-hp gas engine to be direct-connected to a 50-kva, 2300-volt, 60-cycle, three-phase, alternating-current generator, two 175-kva, 2300-volt, 60-cycle, three-phase, alternating-current generators, complete with exciters; one 50-kva, 2300-volt, 60-cycle, three-phase, alternating-current generator, complete with exciter; one five-panel switchboard complete; one 50-light series, luminous or metallic flame arc lamp equipment, complete. Specifications may be obtained from Sidney B. Martin, consulting engineer, Room 616, Penn Building, Pittsburgh, Pa.

DILLSBURG, PA.—The Dillsburg Electric Light & Power Company has executed a mortgage for $20,000 in favor of the Security Title & Trust Company, of York, Pa., to secure a bond issue, the proceeds to be used to acquire real estate and water rights, to erect and equip power-plant and transmission lines to meet the present and future demands made upon it.

DOYLESTOWN, PA.—Plans are being considered by the Philadelphia & Easton Electric Railway Company for building an extension from Lansdale to Doylestown in the spring.

MEYERSDALE, PA.—The Economy Telephone Stock Company has decided to erect a telephone line into Coal Run from Salisbury, and also from Hooversville into Holsopple. C. C. Hedkel is president.

PHILADELPHIA, PA.—It is reported that the Keystone Telephone Company is planning to erect a telephone system and exchange on Five-Mile Beach, to cost about $45,000. The wires will be placed underground.

SCHUYLKILL HAVEN, PA.—The County Commissioners at Pottsville have awarded the contract for the construction of electric power plant, installation of elevators and building sewage disposal plant at the Insane Asylum at Schuylkill Haven, Pa., to the W. G. Cornell Company, of New York, N. Y., for $114,800. Charles T. Straughn, of Pottsville, Pa., is County Controller.

WASHINGTON, PA.—Bids will be received by the Borough Council until Feb. 20 for lighting the borough, except the Eighth Ward, for a period of five and ten years from May 1, 1911. John Griffiths is secretary.

WOMELSDORF, PA.—The Womelsdorf & Rehrersburg Rural Telephone Company has decided to make several extensions to its telephone lines, among which will be the erection of a line to Cross Keys Hotel and vicinity, and an additional circuit to Strausstown.

SAN JUAN, P. R.—The San Juan Light & Transit Company has recently placed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for seven 30-kva, single-phase, 60-cycle, 1100-volt transformers; five 25-kva, single-phase, 60-cycle, 1100-volt transformers and a total of 200 hp in motors for machine shop.

CHARLESTON, S. C.—The Charleston Consolidated Railway & Light Company has recently purchased from the General Electric Company, of Schenectady, N. Y., two 2000-kw turbo-generator sets, two 125-turbo exciters and three 500-kw, 550-volt motor generator sets for its plant in Charleston.

DEADWOOD, S. D.—The Nebraska Telephone Company is reported to be considering an expenditure of $85,000 to complete the improvements started last year.

RAPID CITY, S. D.—The Nebraska Telephone Company, it is said, is contemplating the erection of a new telephone exchange in Rapid City.

MEMPHIS, TENN.—Announcement has been made by the Lake View Traction Company that it will soon begin work on the construction of

its proposed railway. The company holds franchises for seven miles of track in Memphis. W. W. Hayden is engineer.

AUSTIN, TEX.—The Board of City Commissioners has under consideration another offer to rebuild the large dam across the Colorado River and install a hydroelectric plant in Austin. The Dumont-Holmes Steel Concrete Company, which was awarded the contract several months ago, has failed to carry it out and its rights have been declared forfeited by the city. George D. Moore, of Detroit, Mich., has submittd a proposition offering to build the dam and hydroelectric plant for $1,000,000, this sum to be paid in semi-annual instalments of $25,000. The new dam will be located on the site of the one destroyed by the flood several years ago.

BROWNSVILLE, TEX.—The City Council is considering the question of submitting the proposition to issue $40,000 in bonds for additional improvements to the municipal electric light plant and water-works system to a vote of the people. Bonds to the amount of $30,000 were recently issued for this purpose.

EL PASO, TEX.—The County Commissioners are reported to be considering the installation of a lighting plant to light the county buildings.

EL PASO, TEX.—The construction of an electric railway from Engle, N. M., to Fabens, Tex., 100 miles in length, is reported to be under consideration. Richard Burgess, of El Paso, Tex., is said to be interested in the project.

EL PASO, TEX.—Preparations are being made by the El Paso Electric Company for improvements and extensions to its properties to meet the increasing demands made upon them. The company is owned and controlled by the Stone & Webster Corporation, of Boston, Mass.

HOUSTON, TEX.—Arrangements are being made by the Houston-Galveston Interurban Electric Railway Company to begin work on the construction of its extensive terminals in Houston, which with other improvements in this city will involve an expenditure of $500,000.

KIRBYVILLE, TEX.—The installation of an electric light plant iin Kirbyville is under consideration. J. W. Fleming and J. Morton are interested in the project.

LAREDO, TEX.—The Laredo Electric & Railway Company has recently purchased a 400-hp boiler from the Keeler Boiler Company, of Williamsport, Pa.

LONGVIEW, TEX.—The Lacy Telephone Company has awarded a contract for the erection of poles from Longview to the Texas Southern Crossing, a distance of fifteen miles. Contract will soon be let for the remaining fifteen miles to Ore City.

SAN ANTONIO, TEX.—The San Antonio Gas & Electric Company and the San Antonio Traction Company, both controlled by the American Light & Traction Company, are contemplating extensive improvements and extensions to their systems this year.

SULPHUR SPRINGS, TEX.—Plans are being considered for the installation of a new exchange and switchboard in Hopkins in connection with the rural telephone system.

CAMAS, WASH.—The Northwestern Electric Company has applied to the City Council for a fifty-year franchise to supply electricity for lamps and motors in Camas. The company has filed a claim for a dam and power site on the North Fork of the Lewis River.

KOOSKIA, WASH.—Preparations are being made for the construction of a dam across the Middle Fork and the installation of a power plant this year. It is expected that work will begin as soon as spring freshets are over. W. J. Bell, of Newaygo, Mich., and T. H. Croswell, of Spokane, Wash., are interested in the project.

PASCO, WASH.—Arrangements are being made by the Pacific Power & Light Company for the construction of the first unit of its distributing plant, to cost about $83,000. The cost of the plant complete is estimated at $500,000. The company has petitioned the City Council for vacation of a portion of Riverside addition, which it intends to secure for a site for its proposed electric distributing plant and gas plant, work on which will begin in the near future. The generating plant is located on the Nachez River, about ninety miles above Pasco.

SPOKANE, WASH.—Sealed bids will be received by the City of Spokane, Wash., until Feb. 24 for one switchboard, complete; 60 call boxes, complete; 40 signal lamps, 400 storage-battery cells and battery rack, plans and specifications for which are on file at the office of chief of police. John Gifford is purchasing officer.

CAMPBELLSPORT, WIS.—The capital stock of the Campbellsport Electric Light & Power Company has been increased from $10,000 to $40,000.

STOUGHTON, WIS.—Bonds to the amount of $18,700 has been issued for the purchase of the water-power of the Yahara River. Improvements and alterations will be made this spring which will involve an expenditure of about $6,500.

WAUSAU, WIS.—Plans are being made by the Marathon County Telephone Company for the erection of two telephone lines out of Rib Falls, material for which has already been ordered. One line will extend northeast seven miles, and the other south, two miles. F. P. Stone is president.

WAUTOMA, WIS.—The capital stock of the White River Farmers' Telephone Company has been increased from $1,500 to $4,500.

EDMONTON, ALTA, CAN.—The commissioners are contemplating the purchase of a 500-kw motor generator for the substation of the Edmonton Radial Railway, which connects Edmonton and Strathcona. The railway is operated by the municipality. H. A. MacCormack is superintendent.

VANCOUVER, B. C., CAN.—The city electrician will soon ask the City Council for an appropriation of from $150,000 to $200,000 to purchase new equipment and extensions to the present light system during the coming year. The apparatus to be asked for will include 300 arc lamps, 40 fire-alarm boxes, 15 semaphore street signals, 28 miles of wiring, 30 police call boxes and a large number of lamps.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company has awarded the contract for the generating equipment for its new power station, to be erected this summer, to the Canadian General Electric Company. Curtis turbo-generator sets will be installed in four units having a rating of 3000 kw each.

FREDERICTON, N. B., CAN.—It is reported that application will be made at the next session of the Legislature for incorporation of the St. John River Electric Power Company, which proposes to erect a dam across the St. John River, at or near the Hawkshaw bridge, forty miles above Fredericton, to generate and transmit electricity for lamps, heat and motors. John E. Stewart, of Andover, is reported to be interested in the project.

COBALT, ONT., CAN.—The Cobalt Reduction & Refining Company is plannnig to install an electric smelting, reduction and refining plant at its works. It is expected to have the plant in operation by July 1.

IROQUOIS, ONT., CAN.—M. F. Beach, of Iroquois, is reported to be interested in a project to develop a water-power on the Madawaska River, at High Falls, near Calabogie.

LONDON, ONT., CAN.—At the annual meeting of the London Street Railway Company held Feb. 1 the directors decided to abandon the proposals from the Hydro-Electric Power Commission for power from Niagara Falls and go ahead with the construction of a steam power plant.

NIAGARA FALLS, ONT., CAN.—The Niagara Frontier Railway Company will make application to the Ontario Parliament for a charter, giving it power to construct and operate an electric railway from Fort Erie, Ont., through Niagara Falls to the town of Niagara; also to operate telephone and telegraph lines.

OTTAWA, ONT., CAN.—The People's Railway Company, of Berlin, Ont., is applying for a Dominion charter on the ground that several of its proposed terminals are located at ports on international waters, including Owen Sound, Collingwood, on Georgian Bay; Port Dover and Port Stanley, on Lake Erie; Hamilton, on Lake Ontario, and Goderich, on Lake Huron. The company also asks authority to increase its capital stock to $5,000,000 and to develop water-powers as well as to operate steamship lines and elevators.

STRATFORD, ONT., CAN.—The Hydro-Electric Power Commission has appointed Charles J. Leacock supervising engineer of Niagara power system for this district, having jurisdiction over the systems at Stratford, St. Mary's, Tavistock, Mitchell and Seaforth.

MONTREAL, QUE., CAN.—A syndicate, it is reported, has been formed in Montreal for the purpose of constructing an elevated railway, fourteen miles in length, to extend along Craig and St. James Streets from the western to the extreme eastern limits of the city. Another section extending north and south will be built up St. Lawrence, Main or St. Dennis Street.

QUEBEC, QUE., CAN.—The Quebec Railway, Light & Power Company is planning to extend its system from Beauport to Montmorency Falls this year, which will call for the construction of about six miles of track.

PRINCE ALBERT, SASK., CAN.—The City of Prince Albert is reported to have been granted the La Colle Falls power franchise and lands that will be flooded by damming of the river.

SAN LUIS, MEX.—The Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., has recently received an order from the Salvador Madera Cia. of San Luis, Mex., for one 160-kw, direct-current generator.

New Industrial Companies.

THE AVERY-LOEB ELECTRIC COMPANY, of Columbus, Ohio, has been chartered with a capital stock of $25,000 by Oscar Avery, A. E. Loeb, C. W. Mammond, A. U. Loeb and A. L. Frey.

THE GAS POWER MACHINERY COMPANY, of Los Angeles, Cal., has filed articles of incorporation with a capital stock of $200,000. The incorporators are: Lyman Stewart, E. C. Sterling, G. R. Harrison, F. C. Nellis and C. W. Foote.

THE HENRY M. MOSES COMPANY, of Nashville, Tenn., has been incorporated with a capital stock of $5,000 for the purpose of dealing in electrical supplies. The incorporators are: Henry M. Moses, H. C. Keeton, B. A. Massey and others.

JAMES HARTLEY'S SONS, INC., of Brooklyn, N. Y., have filed articles of incorporation with a capital stock of $5,000 to manufacture and deal in engines and machinery. The incorporators are: Thomas Hartley, 4417 Sixth Avenue; John Hartley, 2 Lorraine Street, and James Hartley, 4417 Sixth Avenue, all of Brooklyn, N. Y.

THE McDOWELL, LATIMER COMPANY, of Metuchen, N. J., has been incorporated with a capital stock of $25,000 by H. G. Latimer, G. McDowell, of Brooklyn, N. Y., and R. Borgfeldt, of Metuchen, N. J. The company proposes to manufacture internal combustion engines, etc.

THE MAGNETIC TRANSMISSION COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $100,000 by C. E. Cood, of Brooklyn, N. Y.; C. F. Elliott, of New Brighton, and B. E. Henry, of New York, N. Y. The company is capitalized at $100,000 and proposes to do general contracting and general electrical work of all kinds; also electrical and mechanical engineering business.

THE PARROT HEATER COMPANY, of Jackson, Mich., has been incorporated with a capital stock of $20,000. The company proposes to manufacture gas and electric heaters.

VAILE-KIRNES, of Dayton, Ohio, have filed articles of incorporation with a capital stock of $100,000. The company manufactures hydraulic, electrical and pneumatic machinery. The incorporators are: J. Henry Vaile, Hugh W. Kirnes and others.

THE WARD, DOUCET & FOSTER COMPANY, of Boston, Mass. (electricians), has been incorporated with a capital stock of $50,000 by John B. Ward, William C. Doucet, Almon Foster and John G. Brackett.

New Incorporations.

EUREKA, CAL.—The Humboldt & Eastern Railroad Company has applied for a charter for the purpose of building a railway from Eureka to the Sacramento Valley, via Trinity County. The company is capitalized at $250,000 and the incorporators are: W. S. Clark, C. H. Palmtag, H. J. Jackman and others.

OAKLAND, CAL.—The San José Short Line Railway Company has been incorporated with a capital stock of $80,000 by Gavin McNab, B. M. Aikens, R. P. Henshall, L. Elkins, G. W. Mordecai and F. L. Stewart. The company is a subsidiary of the United Properties Company.

OAKLAND, CAL.—The Sacramento Short Line Railway Company has been incorporated as a subsidiary company of the United Properties Company by B. M. Aikens, Gavin McNab, R. P. Henshall, L. Elkins, G. W. Mordecai and F. L. Stewart. The company is capitalized at $10,000,000.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the California Power & Manufacturing Company, with a capital stock of $5,000,000, by F. G. Baum, C. W. Slack, C. S. Goodard, George R. Roy and J. T. Piggett. The company will operate in northern California.

BRIDGEPORT, CONN.—The Bridgeport Electric Power Company has applied to the Legislature for a charter giving it the right to generate and sell electricity for lamps and motors in Bridgeport and adjacent towns; also to build subways and conduits in Bridgeport and vicinity. The company is to be capitalized at $1,500,000. The incorporators are: W. G. Clark, W. C. Ryckman, C. N. Gilpin and T. F. Fitzsimmons.

BRIDGEPORT, CONN.—Application has been made to the State Legislature by the Pequonnock Company, of Bridgeport, Conn., for a charter in which is included the right to build and operate an electric railway between Bridgeport and Trumbull. It is understood that the primary object of the company is to develop the property in the so-called Thompson tract. The incorporators are: C. Lewis Bill, Theodore B. Ford, F. B. Curtis and Leo C. Morehouse.

FORT LAUDERDALE, FLA.—Articles of incorporation have been filed for the Fort Lauderdale Ice & Light Company with a capital stock of $50,000. The officers of the company are: Henry R. Brown, of Fort Lauderdale, Fla., president; J. L. Billingsley, of Miami, Fla., vice-president; Thomas M. Bryan, secretary, and F. A. Barrett, treasurer, all of Lauderdale, Fla.

ANTIOCH, ILL.—Articles of incorporation have been filed for the Antioch Telephone Company with a capital stock of $2,500 by Wallace E. Drum, Charles T. Richards and Jay E. Cribb.

BRIDGEPORT, ILL.—The Bridgeport Light & Power Company has been chartered with a capital stock of $25,000 by R. D. Donnelly, W. E. Beyhan and B. H. Lytle.

STERLING, ILL.—Articles of incorporation have been filed for the Sterling-Moline Traction Company with a capital stock of $100,000. The company proposes to construct and operate an electric railway from Sterling to Moline, from Sterling to Lyndon, and from Princeton to Prophetstown, Ill. Work will begin on construction of the proposed railway in the near future. Charles E. Windom, of Sterling, Ill., is one of the directors.

BACKUS, MINN.—Articles of incorporation have been filed for the Backus Rural Telephone Company by Laurence Dougherty, J. W. Bailey, O. A. Miller and others.

JOHNS, MISS.—The Johns Telephone Company has been organized to construct and operate a telephone line between Brandon and Johns. The company is capitalized at $25,000 and the incorporators are: H. C. Patrick, J. C. Crain, W. S. Crook, I. P. Russell and others.

MT. VERNON, MO.—The Mt. Vernon Telephone Company has been chartered with a capital stock of $6,000 by John M. Allen, Henry McCanz, Norman Smith and others.

JAMESBURG, N. J.—Articles of incorporation have been filed for the Jamesburg Electric Company by Louis Rafello, Philadelphia, Pa.; Merritt W. Pharo, of Tuckerton, and Milton I. Voorhees, of Jamesburg. The company is capitalized at $10,000 and proposes to supply electricity in Jamesburg for lamps and motors.

WOODMERE, N. Y.—The Woodmere & Rockaway Electric Light & Power Company has been chartered with a capital stock of $100,000 by L. F. Corea, R. Krause, of New York, N. Y., and E. Johnson, of Brooklyn, N. Y.

GRAHAM, N. C.—The Alamance Power Company, of Alamance County, has been incorporated to develop water power and generate electricity on Haw River. The company also has the right to operate cotton mills and do a mercantile business. The company is capitalized at $300,000. The incorporators are: F. L. Williamson, of Burlington; J. Harvey White and E. S. Parker, of Graham.

TULSA, OKLA.—The Sand Springs Interurban Railway Company has been incorporated with a capital stock of $50,000 to build an electric railway from Tulsa to Sands Springs, a distance of six miles. Electricity for operating the proposed railway will be secured of the Tulsa Corporation. The officers of the company are: Charles Page, of Tulsa, Okla., president; W. E. Rohde, Tulsa, superintendent, and W. H. Henderson, chief engineer.

BUTLER, PA.—Application will be made to the Governor by the Pittsburgh, Butler, Slippery Rock, Grove City & Northern Street Railway Company for a charter to construct and operate an electric railway in the Borough of Butler, Borough of Slippery Rock and Borough of Grove City, about twenty-six miles in length. The incorporators are: William C. McCandless, John Troutman, F. L. Forrester, John C. Kerr and William M. Galbraith.

NEW CASTLE, PA.—The Wilmington & Southern Traction Company has been incorporated to take the portion of Wilmington, New Castle & Southern Railway between New Castle and Delaware City, which was recently purchased by R. H. Richards at foreclosure sale.

ANDERSON, S. C.—The Piedmont & Northern Railway Company has been granted a charter with a capital stock of $5,000,000 for the purpose of taking over the property and holdings of the Greenville, Spartanburg & Anderson Railway Company and interurban railways projected. The incorporators are: J. B. Duke, of Somerville, N. J.; B. N. Duke, of New York, N. Y.; W. S. Lee, of Charlotte, N. C.; Ellison A. Smyth and Lewis W. Parker, both of Greenville.

SPRINGFIELD, S. C.—Articles of incorporation have been filed for the Springfield Electric Light & Power Company with a capital stock of $20,000 by J. McB. Dean, Michael Cleaton, E. J. Boland, J. B. Smith and others.

PIERCE, S. D.—The Omaha & Western Iowa Traction Company has filed articles of incorporation with a capital stock of $250,000. The incorporators are: C. E. Brown, M. E. Gallion, C. Desmond McDonough and others.

CELINA, TEX.—The Celina Electric Light & Power Company has been incorporated with a capital stock of $5,000 by W. I. Bryan, Edward Langford and V. L. Patrick.

ALUM RIDGE, VA.—The Floyd-Montgomery Telephone Company has been incorporated with a capital stock of $10,000. The officers of the company are: W. W. Thompson, of Sowers, Va., president; M. R. Gordon, of Copper Valley, Va., vice-president, and R. T. Akers, of Alum Ridge, Va., secretary and treasurer.

NICKELSVILLE, VA.—Articles of incorporation have been filed for the Dungannon & Nickelsville Telephone Company with a capital stock of $5,000 by J. W. Broadwater, president; J. J. Quillan, vice-president; R. L. McConnell, J. W. Bostix and others.

VANCOUVER, WASH.—Articles of incorporation have been filed for the Northwestern Electric Company with a capital stock of $5,000,000 by B. A. De Yarmon, of Vancouver, Wash.; B. C. Conduit, of Oakland; C. E. S. Wood, H. H. Parker and Erskine Wood, of Portland, Ore. The company has filed on water rights in the Lewis River which provide for 10,000 cu. in. per second.

CLARKSBURG, W. VA.—The Domestic Fuel & Light Company has been granted a charter with a capital stock of $50,000. The incorporators are: Angus W. McDonald, John Wehrle, George S. Crouch, Jr.; E. W. Knight and C. C. Stone, all of Charleston, W. Va.

CLIFFTOP, W. VA.—The North Fayette Telephone Company has been chartered with a capital stock of $5,000. The incorporators are: R. L. Walker, John E. Hugart and others.

CAZENOVIA, WIS.—Articles of incorporation have been filed for the Westford Telephone Company with a capital stock of $1,000 by John Keller, Peter Milford, Joseph Duren, F. Rockweller and J. M. Bauer.

HINTZ, R.F.D., UNDERHILL, WIS.—The Lonzy Brook Telephone Company has been formed with a capital stock of $6,000 by H. H. Behn and others.

OTTAWA, ONT., CAN.—The High River, Saskatchewan & Hudson Bay Railway Company will apply to the Dominion Parliament for a charter to construct and operate an electric railway in the Provinces of Alberta and Saskatchewan, thence to Pas, in the Northwest Territories.

JOLIETTE, QUE., CAN.—The Joliette & Lake Manuan Colonization Railway Company has made application to the Dominion Parliament for a charter to construct a railway from Joliette, Que., to Montreal, to be operated either by steam or electricity.

Personal.

DR. J. E. WHITEHEAD, professor of applied electricity at the Johns Hopkins University, lectured last week on "Recent Progress in the Art of Illumination" before the Baltimore University Club.

MR. L. H. LATHROP has been appointed superintendent of the Menominee & Marinette Light & Traction Company, of Menominee, Mich., succeeding Mr. W. R. Putnam, whose resignation was announced in these columns Jan. 19.

MR. EDWARD J. O'HAYER, JR., general Eastern passenger agent of the New York Central Lines, was married Feb. 8 in Indianapolis to Miss Ada Moore Alexander. The happy couple will reside at the Hotel Marie Antoinette, New York City.

MR. W. H. GLENN has been elected vice-president of the Georgia Railway & Electric Company, Atlanta, Ga., in recognition of his valuable services to the company. Mr. Glenn is a graduate of the Georgia School of Technology and has been connected with the company since 1891.

MR. THOMAS A. EDISON celebrated the sixty-fourth anniversary of his birth on Feb. 11 by a particularly busy day at his laboratory in Llewellyn Park, Orange, N. J. He received telegrams of congratulation from a number of the leaders in the electric lighting industry and other scientific fields.

PROF. D. C. JACKSON returned Feb. 7 from a flying trip to England, where he made preliminary arrangements for a report to the British government in connection with the valuation of the telephone system of the National Telephone Company, which is to be taken over by the government on Jan. 1, 1912.

MR. HARRY CURTIS RICE, vice-president and manager of the General Incandescent Lamp Company, of Cleveland, Ohio, was married Feb. 7 to Miss Edna Tyler Kindelon, of Oakland, Cal. The ceremony was performed in Lynn, Mass., Mr. Rice's former home. Mr. and Mrs. Rice are spending their honeymoon on an excursion through the Southern States.

COLONEL E. E. NASH, secretary-treasurer of the Warren Electric and Specialty Company, addressed the Business Men's Association of Warren, Ohio, at its annual meeting, directly following a noon lunch on Friday, Feb. 3. He referred to the relation of the National Electric Lamp Association with Warren, which city is the headquarters of no less than five of the association's member companies.

MR. JOHN I. BEGGS, president of the Milwaukee Electric Railway & Light Company, has been elected president of the St. Louis Car Company, of St. Louis, Mo. The election took place at the recent annual meeting, which was the first held by the corporation since its reorganization by Mr. Beggs. Mr. Edwin Missner, chief clerk of the Milwaukee Electric Railway & Light Company, has been appointed assistant to the president.

MR. H. M. BEECHINOR, formerly with the Allegheny Light Company, of Pittsburgh, has been appointed Cleveland representative of the American Electric Fuse Company, with offices at 423 High Avenue. Mr. W. W. Walsh, formerly of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, will act as the Pittsburgh representative of the American Electric Fuse Company. His office will be at 409 House Building.

MR. F. H. ENSIGN, manager of the Pacific Gas & Electric Company at Phoenix, Ariz., for the past five and one-half years, has resigned that position in order to devote his time to personal interests. He has become financially interested in the New State Electric Supply & Fixture Company and the New State Auto Aerial Company and assumes the management of both concerns in addition to other personal interests in Phœnix and throughout the valley. Mr. Ensign retains a connection with the Pacific Gas & Electric Company as consulting engineer. Mr. R. G. Whitmarsh has been elected by the officials of the company to succeed Mr. Ensign as manager.

MR. B. S. BARNARD, who has been associated for the past fifteen years with the Standard Vitrified Conduit Company, of which for the past several years he has been president, on Jan. 1 became interested in the Clermont Sewer Pipe Company, of Clermont, Pa. This company will place on the market a high grade of vitrified clay conduit, both multiple and single duct. Its property includes deposits of clay, shale and coal and natural gas, located so centrally as to secure the advantage of low freight rates in all directions. Mr. Barnard's New York office is 50 Church Street, and his plant starts up March 1.

B. S. BARNARD.

MR. G. W. BRINE has resigned as treasurer of the Georgia Railway & Electric Company, being succeeded by Mr. I. S. Mitchell, Jr., formerly cashier of the company. Mr. Brine still retains his connection with the company, however, being vice-president and secretary and one of the directors. Mr. Brine, although born in New England, has been associated with Southern electrical developments for a number of years. His entry in the electric light field was made in 1884, when he was connected with the southern district of the Edison General Electric Company. In 1894 he accepted a position with the Georgia Electric Light Company, where his steady application to the interests of the company resulted in his promotion to be secretary-treasurer and manager. When in 1902 the company was consolidated with the railway and other lighting companies in Atlanta into the Georgia Railway & Electric Company he was made vice-president and treasurer and manager of the electric department.

MR. DAVID HARLOWE, traffic manager of the Allis-Chalmers Company, of Milwaukee, has been appointed by the Wisconsin Railroad Commission to fill the place of Prof. B. H. Meyer, resigned. Mr. Harlowe has been connected with the Allis-Chalmers Company for over twenty-five years, becoming traffic manager of the old E. P. Allis Company in 1893. Before this he was associated with Mr. Dwight W. Keyes, general freight agent of the Chicago, Milwaukee & St. Paul Railroad. Mr. Harlowe was born in England in 1860. Several years ago a place on the commission was offered to him, but at that time he declined to serve. His four-year term begins this month.

Obituary.

MR. SAMUEL A. BUFFINGTON, president of the Consolidated Gas & Electric Company, of Chicago, died on Feb. 8 of inflammatory rheumatism following grip. He was thirty-eight years of age. While the company of which Mr. Buffington was president at the time of his death is engaged in gasoline lighting, the decedent was well known in electrical circles, as he established the Chicago Telephone Supply Company in 1898 and was also interested in electrical manufacturing enterprises. He was also president of the Land Company of North America and president of the Giant Construction Company, which founded the town of New Chicago, Tex.

MR. PARMALEE J. McFADDEN died at his home in Greenwich, Conn., on Feb. 9. Some years ago Mr. McFadden was engaged in electrical pursuits in Chicago, where he is pleasantly remembered. He had charge of a department in the Chicago office of the old Edison General Electric Company and was afterward connected with the General Electric Company in Chicago for a short time. He was a man of literary and scholarly tastes, and while in Chicago was an occasional contributor to the technical press. Afterward he engaged in literary work for A. C. McClurg & Company in Chicago and Dodd, Mead & Company in New York. At the time of his death he was associate editor of the *St. Nicholas* magazine.

Trade Publications.

RECORDING THERMOMETERS.—Bulletin No. 127 issued by the Bristol Company, Waterbury, Conn., is a forty-page illustrated catalog of the company's Class III recording thermometers, including description and lists of the compensated, gas-filled recording thermometers. A number of important applications are mentioned.

HOW TO READ ELECTRIC METERS.—"Electric Meters: How to Read Them" is the title of a booklet just issued by the Westinghouse Electric & Manufacturing Company. As the title suggests, the booklet is intended as an instruction in the reading of watt-hour meters for the layman, and to this end it is written in a popular style, easily understood by anyone.

GRAPHIC RECORDERS.—The Sangamo Electric Company, Springfield, Ill., is distributing Bulletin No. 22, describing its portable and switchboard type of graphic recorders. Several pages are devoted to a discussion of the application of the graphic recorders to soliciting power, checking input of electrically driven machines, etc. The bulletin should prove of assistance to central-station managers confronted with the day-load problem.

GENERAL ADVERTISING LITERATURE.—For the purpose of placing before the electric-lighting industry information concerning the advertising campaign which it has pursued, with the idea of convincing the public that electric light is now cheaper, the General Electric Company has isued a pamphlet entitled "How the General Electric Company Is Enlightening Eighteen Million People." The company hopes to induce lighting companies to co-operate in further advertising locally along similar lines with material placed at their disposal by it.

BUSINESS NOTES.

MR. WILLIAM T. DONNELLY, consulting engineer, has removed his offices from 135 Broadway to the Whitehall Building, 17 Battery Place, New York City.

PAWLING & HARNISCHFEGER COMPANY, Milwaukee, Wis., builders of cranes, hoists, etc., announce the opening of a branch office at 533 Baronne Street, New Orleans, La., under the management of Mr. T. W. Waddell.

THE BOSTON INCANDESCENT LAMP COMPANY has just completed a two-story addition, 80 x 36 ft., to its factory at 128 Maple Street, Danvers, Mass. This company manufactures the well-known "Boston" renewed lamp, and by the addition of this new space its facilities for the production of these lamps are now largely increased.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 7, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

983,275. ELECTRIC SWITCH; F. H. Hallefas, Chicago, Ill. App. filed May 28, 1910. For reversing the current supplied to the motor, the switch having upstanding spaced ends, a pair of stationary contacts to coöperate with the ends and a movable contact for connecting the switch and ends.

983,291. ELECTRIC HEATER; M. M. Kohn, New York, N. Y. App. filed Oct. 1, 1909. Heater has a body with upwardly extending wall, a plurality of forms adjacent to the wall, an electric conductor in each form, the forms being removable and shaped to conform to the wall.

983,292. ELECTRIC HEATER; M. M. Kohn, New York, N. Y. App. filed Oct. 30, 1909. A base, a plurality of coil holders of rectangular form removably screwed thereto and a heating coil in each holder with a switch for throwing the coils in series or multiple.

983,303. ELECTRIC FURNACE; H. Nathusius, Friedenshutte, Germany. App. filed May 6, 1908. A furnace with a hearth, carbon electrodes above the hearth and steel electrodes in the base of the hearth, adjacent electrodes differing in polarity throughout the hearth.

983,306. AUTOMATIC FIRE ALARM; E. F. Oliver, Monroe, Ind. App. filed Dec. 4, 1909. Automatically liberates a fire extinguishing gas and sounds a local alarm when the temperature reaches a certain degree and sounds a fire-station alarm when the temperature reaches a certain degree above the local alarm sounding degree.

983,308. ARMATURE FOR MAGNETO ELECTRIC MACHINES; C. A. Pfanstiehl, Highland Park, Ill. App. filed April 18, 1910. For spool type magnetos, a removable core forming a bundle of wires whose ends are connected to the pole pieces.

983,345. THERMOSTAT; J. Boekel, Philadelphia, Pa. App. filed April 30, 1910. Adjustable thermostat with mercury chamber and controllable air outlet to provide an adjustment for varying the sensitiveness of the thermostat.

983,360. X-RAY FRAME; A. Granger, New Orleans, La. App. filed June 20, 1910. X-ray camera mounted upon sliding standards with fluorescent screen.

983,361. BACK-GEARED MOTOR; A. M. Gray, Milwaukee, Wis. App. filed Feb. 28, 1910. Low-geared motor in which the frame comprises a field yoke and end heads with supporting portions and a counter shaft on the yoke, the ends being stationary and the yoke adjustable.

983,364. FIXTURE LAMP; M. Harris, Pittsburg, Pa. App. filed Nov. 11, 1908. A lamp with separately located glowers, a heater near each glower and a ballast and cut-out in circuit with each heater and glower.

983,373. DEVICE FOR LAYING UNDERGROUND WIRES; J. M. Jones, Buffalo, N. Y. App. filed Sept. 21, 1910. Does away with rods by using a linked structure or chain with means for keeping the leading links rigid.

983,380. CONTROLLER; C. E. Lord, Norwood, Ohio. App. filed June 30, 1906. A controller with casing, a switch outside of the casing open to the atmosphere operated by the controller upon abnormal circuit conditions.

983,399. RECIPROCATING MECHANISM; H. H. Ralston, Norwood, O. App. filed April 20, 1907. For giving an axial reciprocating movement to the brushes of the dynamo to change the wear point on the commutator.

983,403. ELECTRICAL SIGNALING DEVICE; J. G. Schafer, Brighton, Iowa. App. filed May 24, 1909. For country mail boxes which by means of circuit wires closes an alarm in the house when a letter is deposited in the box.

983,414. APPARATUS FOR REGULATING OR CONTROLLING THE PRESSURE OF THE CURRENT IN AN ELECTRIC CIRCUIT; J. Watkinson & A. E. Payne, London, England. App. filed June 13, 1910. For regulating or controlling the pressure of the current by means of a switch arm moving over resistances, each consisting of cells of graphite, the arm carrying a roller which bears upon the contacts and having flat springs for further contact.

983,430. PROCESS OF MANUFACTURING IRON ELECTRODES FOR USE IN ALKALINE ACCUMULATORS; Axel Theodor Konstantin Estelle, Fliseryd, Sweden. App. filed March 19, 1910. Subjects an iron salt to electrolysis in the presence of a solution in another metal insoluble in alkaline solutions.

983,443. ELECTRICAL ALARM THERMOMETER; R. Heddle, Nelson, British Columbia, Canada. App. filed June 21, 1909. An alarm thermometer with graduated scale and sliding contact, a thermostat bar, a pin extending therefrom, an indicator engaged by the pin and an alarm controlled thereby.

983,453. METHOD OF TREATING ORES BY THE BLAST FURNACE PROCESS; F. A. Kjellin, Stockholm, Sweden. App. filed Oct. 23, 1909. Feeds iron ore and fuel into a blast furnace, heats the entire charge and then passes an electric current through the charge in that section of the furnace where the reduction of the lower oxides of iron to metallic iron begins.

983,489. IGNITER; H. N. Fullerweider, Waveland, Ind. App. filed April 18, 1910. Clamp for gas burners with improved guards for preventing the electrode conductor wires from accidental engagement with the burner stem.

983,491. SANITARY APPLIANCE FOR TELEPHONES; G. T. Hadley, San Francisco, Cal. App. filed Jan. 10, 1910. Hollow globe of thin metal which is perforated and fits over the receiver mouthpiece.

983,500. ELECTRIC REGULATOR; H. K. Kouyoumkian, St. Louis, Mo. App. filed April 26, 1910. Cuts resistance coils in and out by means of a movable arm operating over two sets of contacts, the resistances being in two series with the arm pivoted between the contacts.

983,519. MOTOR CONTROL SYSTEM; E. W. Stull, Milwaukee, Wis. App. filed Sept. 10, 1909. Motor-controlled system for a plurality of motors with a power-operated controller for varying the resistance and a manually-operated master controller for putting the motors in series and partly in parallel.

983,536. METHOD OF REMOVING STATIC ELECTRICITY; W. H. Chapman, Portland, Maine. App. filed Jan. 23, 1908. Charges an insulated conductor with an alternating charge of high voltage and passes the paper or yarn within the electrostatic field and places near it a small conductor which is grounded.

983,548. METHOD AND APPARATUS FOR EQUALIZING TEMPERATURE; H. B. Gale, Cambridge, Mass. App. filed Sept. 19, 1910. Electric heater for heating a liquid as part of a heating system, the extent of the heat-conducting surface between the heater and the liquid being adjusted and the supply of current controlled upon changes in temperature of the heater.

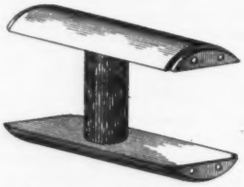
983,558. ELECTRIC SIGN; E. A. Leopoldt, Cincinnati, Ohio. App. filed Oct. 9, 1909. An elongated electric socket with side and bottom contacts to form connection with an incandescent lamp with the terminals of the lamp at selective points lengthwise of the socket.

983,570. HOLDER FOR TELEPHONE RECEIVERS AND THE LIKE; S. K. Rothschild, Detroit, Mich. App. filed Nov. 4, 1910. Telephone receiver with an outer casing and ball bearings between the receiver and the casing, the latter serving as a handle, so as to prevent twisting of the cords.

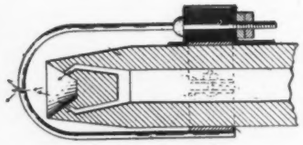
983,573. SUSPENDED INSULATOR; C. W. Schultz, Scranton, Pa. App. filed Jan. 3, 1910. Suspended insulator for trolley wires, including a shell for holding the insulating material tapped to receive a screw bolt and an annular recess to receive the supporting pipe.

983,660. ELECTRIC SWITCH; C. S. Van Nuis, Philadelphia, Pa. App. filed July 26, 1907. A switch in which a stationary contact is retained within the base by means of a molded mounting with a wedge for securing the mounting to the base.

983,670. ALTERNATING CURRENT SYSTEM OF DISTRIBUTION, REGULATION AND CONTROL. J. Bijur, New York, N. Y. App. filed March 29, 1906. Alternating current supply, alternating work circuit, storage battery compensating for variations in load and a regulator operating when the load on the work circuit varies from the average.



983,308.—Armature for Magneto Electric Machines.



983,489.—Igniter.

983,701. INSULATOR FOR ELECTRIC INSTALLATION CANOPIES; G. W. Gardiner, Chicago, Ill. App. filed Sept. 12, 1910. A canopy with central opening, a conduit passing through it and a hard rubber sleeve on the conduit passing through the opening, the canopy being held in position by a nut on the sleeve.

983,703. ELECTRICAL WRITING APPARATUS; D. P. F. Ghadiali, Surat, Ind. App. filed May 21, 1909. High-tension currents supply a tool for writing, the pen including a tube with an enlargement to receive mercury in which tube wires are arranged, connected by the mercury and a needle is resiliently mounted to make a contact.

983,713. FIRE ALARM; S. J. Heinrich, Bellevue, Pa. App. filed March 14, 1906. A fire alarm with clock train operating an indicator arm which passes over a dial with a sector connected with the arm, a lever having an armature, a magnet attracting the armature, a circuit for the magnet with controlling means for the lever operated by the train and a thermostat in the circuit.

983,717. ELECTRIC TOY; A. Huck, Nuremberg, Germany. App. filed March 29, 1910. Toy motor for toy locomotives which can be detachably secured to the locomotives and also taken apart. Details.

983,727. ELECTROCHEMICAL PROCESS FOR CLEANING AND POLISHING SILVER PLATE AND THE LIKE; A. M. Kohler, Brixton, London, Eng. App. filed July 6, 1909. Immerses the article and aluminum in a receptacle containing an aluminum salt solution, liberates hydrogen thereby which combines with the oxide and then dries the article.

983,742. ELECTRIC HAND LAMP; J. W. Mead, Buffalo, N. Y. App. filed April 20, 1910. A magneto with its magnet constructed to form the handle and an incandescent lamp on the magnet in circuit with the armature of the magneto.

983,760. BATTERY AND HOLDER; G. L. Patterson, New York, N. Y. App. filed May 26, 1908. A frame carrying cell connectors, one including an annular conductor plate with a series of cell-engaging spring fingers projecting therefrom and a resilient connector in electrical connection therewith, its outer end being within the open center of an adjacent conductor plate.

983,815. FLEXIBLE CONDUIT FOR ELECTRIC CONDUCTORS; C. A. Flack, Parnassus, Pa. App. filed Dec. 31, 1908. Non-metallic flexible conduit with an inner textile tube covered by a spiral strip with spaced edges and a textile covering and binding over the tube.

983,817. ELECTRIC CIRCUIT CONTROLLING MEANS; C. J. Fox and W. C. Grein, Rochester, N. Y. App. filed July 9, 1910. Push button switch with a key for closing the opening into which the plug is inserted, which can be made inoperative, can establish a connection with other contacts, or open them for safety.

983,835. POWER FACTOR CONTROLLER; J. Pearson, Somerset, Wis. App. filed July 20, 1907. For varying the power factor on an alternating circuit by means of synchronous machines running in parallel, and an exciter in the field of one, a rheostat in the field of the exciter, reverse acting solenoids for adjusting the rheostat, reverse acting relays for controlling the solenoids, electrical connections with fixed contacts for rendering the relays reverse-acting, and an automatic power factor regulator with fixed and movable windings, one responsive to current changes and the other to voltage changes.